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CONTENTS

No. 1, May, 1938

[Issued July 26, 1938]

Page.

TUBANGUI, MARCOS A., and VICTORIA A. MASILUÑGAN. Nephridiorhynchus palawanensis sp. nov., an acanthocephalan parasite of Manis javanica Desmarest 1
One plate and one text figure.

ROLDAN, E. F. New or noteworthy lower fungi of the Philippine Islands, II 7
Four plates.

RABOR, DIOSCORO S. Birds from Leyte 15

VILLALUZ, DOMICIANO K., and FELIX J. ARRIOLA. Five other known species of Penæus in the Philippines 35
Four plates.

SKVORTZOW, B. W. Diatoms from Argun River, Hsing-An-Pei Province, Manchoukuo 43
Two plates.

MYERS, ROLLIN G. The effect of arsenic, vanadium, iron, and tin on the determination of antimony in high-lead mixtures by a modified permanganate method 75

ALEXANDER, CHARLES P. New or little-known Tipulidæ from eastern Asia (Diptera), XXXVI 93
Three plates.

BOOKS 135

No. 2, June, 1938

[Issued September 5, 1938]

QUISUMBING, EDUARDO. Studies on Philippine orchids, I 141
Seven plates.

PARAS, ERNESTO M. Chemical fractionation of leprotic nodules, I. Isolation of the lipid fractions 155

SKVORTZOW, B. W. Diatoms from a peaty bog in Lianchiho River valley, eastern Siberia 161
Three plates.

YAP-CHIONGCO, JOSE V. The littoral Paguridea in the collection of the University of the Philippines 183
Two plates.

ALEXANDER, CHARLES P. New or little-known Tipulidæ from eastern Asia (Diptera), XXXVII 221
Three plates.

ROXAS, HILARIO A., and GUILLERMO L. ABLAN. A new tænioid fish from Occidental Negros 261
Two plates.

Page.

RABOR, DIOSCORO S. The avifauna of the Gigante Islands 267

BOOKS 275

No. 3, July, 1938

[Issued October 3, 1938]

ACEVEDO, RAMON A., and TEODULO TOPACIO. Differentiation of cattle and carabao meat by biochemical methods, I. Differentiation of unrefrigerated and frozen meat 281

Two plates.

AFRICA, CANDIDO M. Description of three trematodes of the genus Haplorchis (Heterophyidæ) with notes on two other Philippine members of this genus 299

Two plates.

ALEXANDER, CHARLES P. New or little-known Tipulidæ from eastern Asia (Diptera), XXXVIII 309

Three plates.

SKVORTZOW, B. W. Diatoms from a mountain bog, Kaolingtze, Pin-Chiang-Shen Province, Manchoukuo 343

Two plates.

MENDOZA, JOSÉ MIGUEL, and SIMEONA LEUS-PALO. A revision of Philippine Lepiota 363

Seven plates.

ABLAN, GUILLERMO L. The diwal fishery of Occidental Negros 379

Two plates.

MARTIN, CLARO. Two rare Philippine fishes 387

One plate.

BOOKS 391

No. 4, August, 1938

[Issued October 18, 1938]

GUTIERREZ, M., and F. O. SANTOS. The food consumption of one hundred four families in Paco District, Manila 397

VANOVERBERGH, MORICE. 'To Have' and 'To Be' in Iloko 417

ALEXANDER, CHARLES P. New or little-known Tipulidæ from eastern Asia (Diptera), XXXIX 439

Four plates.

SKVORTZOW, B. W. Diatoms from Chengtu, Szechwan, western China 479

Four plates.

ABLAN, GUILLERMO L., and GODOFREDO L. ALCASID. Two species of Pinna apparently new to the Philippines 497

One plate.

BLANCO, GUILLERMO L. Fisheries of northeastern Luzon and the Babuyan and Batanes Islands 501

Five plates.

BOOKS 523

INDEX 531

THE PHILIPPINE JOURNAL OF SCIENCE

VOL. 66 MAY, 1938 No. 1

NEPHRIDIORHYNCHUS PALAWANENSIS SP. NOV., AN ACANTHOCEPHALAN PARASITE OF MANIS JAVANICA DESMAREST

By MARCOS A. TUBANGUI and VICTORIA A. MASILUÑGAN

Of the Bureau of Science, Manila

ONE PLATE AND ONE TEXT FIGURE

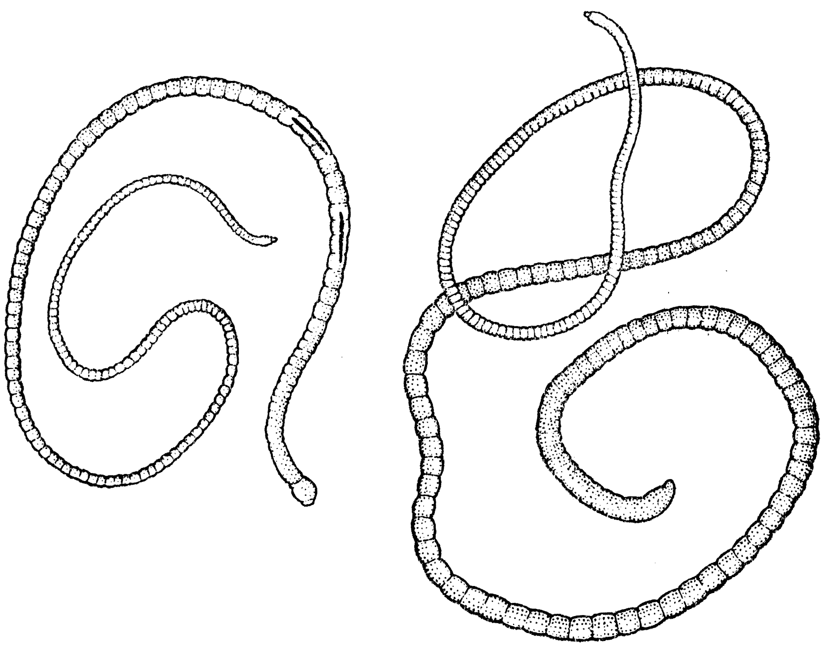
Among some helminths found in the intestines of a pangolin, *Manis javanica* Desmarest, 1882, which was received for dissection through the courtesy of Dr. C. Manuel, of the Fish and Game Administration of the Bureau of Science, were a number of mature and immature specimens of what appears to be a new species of proboscis worm. Recently Meyer (1931) described from *Manis tricuspis*, the African pangolin, *Nephridiocanthus manisensis*, with which the Philippine parasite was thought to be at least congeneric. A closer examination of the specimens, however, showed definitely their position in the genus *Nephridiorhynchus* Meyer, 1931. For this reason the name *Nephridiorhynchus palawanensis* is proposed for the new parasite.

Description.—Adult worms very elongate, cylindrical, slightly compressed laterally, distinctly pseudosegmented except near extreme anterior and posterior ends. Anterior third or fourth of body length in both sexes smaller in diameter and much lighter in color; rest of body grayish. Male smaller than female, 190 to 280 millimeters long by 2.2 millimeters in dorsoventral diameter; female 210 to 360 by 2.3 to 2.6 millimeters.

Proboscis with an apical papilla, subspherical, 0.47 to 0.50 by 0.40 to 0.42 millimeter, armed with 48 hooks arranged in 8 ante-

roposterior rows of 6 hooks each, or, using another terminology, in 6 spiral rows of 8 hooks each. Hooks with more or less prominent subterminal barbs except those of last two posterior rows, varying in size, the first and fifth circles of hooks being largest and those of the seventh and eighth rows smallest, as shown by the following figures:

Row.	Length of hooks. μ
1	98.2–105.8
2	75.6– 92.6
3	75.6– 96.4
4	75.6– 90.7
5	98.2–102.0
6	90.7–100.0
7	75.6– 83.0
8	75.6– 83.0



Nephridiorhynchus palawanensis sp. nov., natural size. *a*, Male; *b*, female.

Neck slightly shorter than proboscis, free from spines, with a pair of large lateral papillæ near its junction with proboscis.

Proboscis sheath double-walled, 1.5 to 1.6 by 0.50 to 0.58 millimeters. Nerve ganglion large, oval, behind middle of length of proboscis sheath.

Lemnisci 6.5 to 11.0 millimeters long, one usually longer than the other, each with a small central canal and five large oval nuclei.

Testes elongated, one behind the other, 5.0 by 0.45 millimeters, separated by a distance of 4.5 to 6.5 millimeters, posterior testis about 26 millimeters from posterior end of body. Number of cement glands could not be definitely determined. Cement reservoir 4.8 by 1.2 millimeters. Bursa well developed and supported by rays like the bursa of certain nematodes.

Uterine bell 1.2 millimeters long, uterus proper 2.7 and vagina 0.4 millimeters.

Eggs oval, 68 to 72 by 47 to 53 microns, provided with three thick coverings; middle and inner shells separated by a space, outer shell pierced by numerous radial canallike structures leading to the surface and producing in the latter a punctate appearance.

Protonephridial organs appear as oval granular masses, one on each side of anterior extremity of uterine bell of adult female. Chief longitudinal vessels of subcuticula consist of a dorsal and a ventral canal.

The immature worms resemble in external appearance *Oligacanthorhynchus pomatostomi* (Johnston and Cleland, 1911) Tubangui, 1933, a larval Acanthocephala found encysted under the skin of birds in Australia and the Philippines. In the morphology of the proboscis, however, and other anatomical details, they agree with the adult parasites, as described above. The males measure 4.2 to 8.0 by 0.75 to 0.85, the females 5.4 to 14.6 by 0.85 to 0.95 millimeters. Proboscis 0.38 to 0.42 by 0.39 to 0.44 millimeter, proboscis sheath 0.95 to 1.10 by 0.33 to 0.35 millimeters. Proboscis hooks practically as large as those of adult worms. Lemnisci 5.6 to 5.9 millimeters long. Testes oval, one immediately behind the other, 0.15 to 0.30 by 0.08 to 0.11 millimeter.

Host.—*Manis javanica* Desmarest, 1882.

Location.—Small intestine.

Locality.—Palawan Island.

Type specimens.—Philippine Bureau of Science parasitological collection No. 526.

The new parasite differs from *Nephridiorhynchus major* (Bremser, 1811) Meyer, 1931, the type and thus far the only species of the genus, in the following respects: (*a*) it is much

bigger, being at least three to four times as long as *N. major;* (*b*) the last two rows of proboscis hooks are not barbed, while in *N. major* it is the first two rows of hooks that are not provided with barbs; (*c*) the lemnisci possess only five nuclei each instead of nine, like *N. major;* (*d*) the eggs are smaller and the external shell covering differs in structure from that of *N. major.*

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MEYER, A. Neue Acanthocephalen aus dem Berliner Museum. Zool. Jahrb. Abt. f. Syst. 62 (1931) 53–108.

TUBANGUI, M. A. Notes on Acanthocephala in the Philippines. Philip. Journ. Sci. 50 (1933) 113–128.

ILLUSTRATIONS

PLATE 1. NEPHRIDIORHYNCHUS PALAWANENSIS SP. NOV.

FIG. 1. Anterior end, showing proboscis, proboscis sheath, and lemnisci.
2. Proboscis, showing arrangement of hooks.
3. Cross section through proboscis sheath.
4. Posterior end of female, showing protonephridial organ, uterine bell, uterus, and vagina.
5. Egg.

TEXT FIGURE

Nephridiorhynchus palawanensis sp. nov., natural size. *a*, Male; *b*, female.

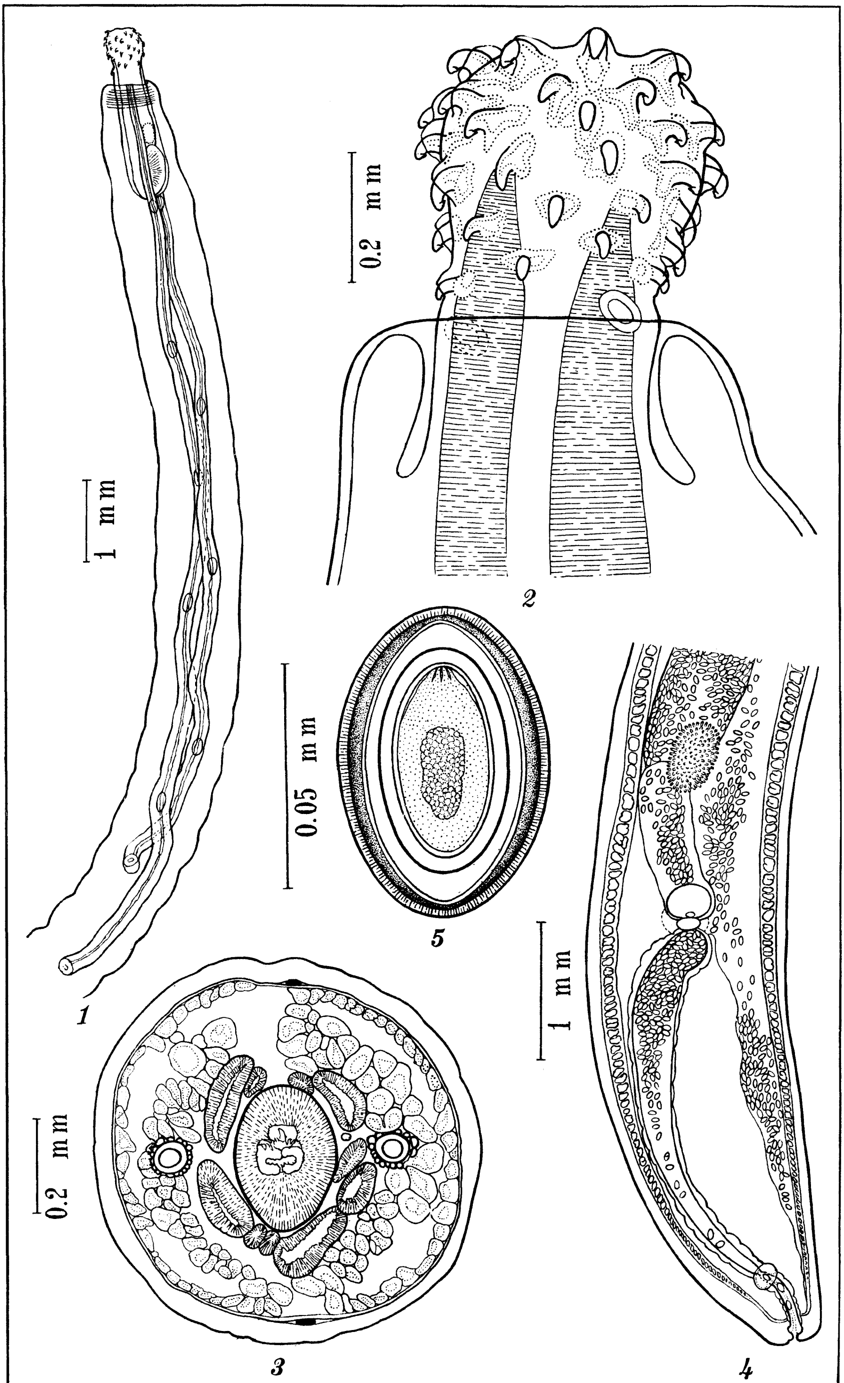

PLATE 1. NEPHRIDIORHYNCHUS PALAWANENSIS SP. NOV.

NEW OR NOTEWORTHY LOWER FUNGI OF THE PHILIPPINE ISLANDS, II [1]

By E. F. Roldan [2]

Of the Department of Plant Pathology, College of Agriculture, Los Baños Laguna

FOUR PLATES

This paper is the second [3] of a series of articles reporting new or noteworthy lower fungi of the Philippine Islands. In this article twelve species of lower fungi are recorded; six of these are described as new, and six as recorded for the first time from the Philippines. The material has been collected by the writer.

The type specimens of the six new species are deposited in the Baker Herbarium of the Department of Plant Pathology, of the College of Agriculture, Los Baños, Laguna, Philippine Islands.

CERCOSPORA VAGINAE Kruger.

Cercospora vaginae Kruger in Mededeel. Zuiker. West Java (1896) 29.

The fungus produces bright-red irregular patches, visible from both sides, on the leaf sheaths of sugar cane. The spots may increase in size and become confluent. The lesions may involve extensive areas, causing blight of the leaf sheath, and bringing about premature death of the leaves (Plate 1, fig. 4).

Mycelium effuse, olive brown, septate. Conidiophores arising from mycelium, erect, short, simple, solitary. Conidia subclavate or subcylindric, hyaline, pleurogenous, 0- to 3-septate, 12.5 to 37 x 3 to 6.5 μ (Plate 3, fig. 1).

Luzon, Laguna Province, College of Agriculture campus, *E. F. Roldan 35*, June 19, 1936, on living leaf sheaths of *Saccharum officinarum* Linn.

This fungus was described by Kruger in Java in 1896 as causing red blight on the leaf sheath of sugar cane. It was

[1] Contribution No. 1227 from the Experiment Station of the College of Agriculture, Los Baños, Laguna. Published with the approval of the Dean of the College of Agriculture.

[2] The writer acknowledges his indebtedness to Dr. Eduardo Quisumbing, of the Bureau of Science, Manila, for comments and criticisms.

[3] The first paper of this series appeared in Philip. Journ. Sci. 60 (1936) 119.

later reported from Mauritius, Cuba, Puerto Rico, the West Indies, and Brazil. It is new to the Philippines.

CERCOSPORA FULIGENA sp. nov.

Caespitulis, sparsis, hypophyllis, brunneolus vel atro-brunneis, angularibus vel saepe venis limitatis; conidiophoris brunneis, simplicis, fasciculatis, subgeniculatis, septatis, 26 ad 67 x 3.7 ad 5 μ; conidiis clavatis vel subclavatis, lentiner curvatis, subhyalinis, acrogenis, 1 ad pluriseptatis, 15 ad 118 x 3.5 ad 5 μ.

The fungus forms thin brown to dark-brown colonies on the undersurface of the leaf. Colonies angular, indefinite, sometimes limited to veins. Conidiophores brown, simple, fasciculate, subgeniculate, septate, 26 to 67 x 3.7 to 5 μ. Conidia clavate to subclavate, slightly curved to subhyaline, 1- to several-septate, acrogenous, 15 to 118 x 3.5 to 5 μ (Plate 3, fig. 2).

LUZON, Laguna Province, College of Agriculture campus, *E. F. Roldan 32,* March 5, 1934, on living leaves of *Lycopersicum esculentum* Mill.

Cercospora cruenta Sacc., causing leaf spot on tomato, was reported from the United States. *Cercospora fuligena* appears to be distinct from *C. cruenta* in that the Philippine species does not produce spots. Instead it forms dark-brown colonies composed of tufts of conidiophores on the undersurface of the leaves.

CYLINDROSPORIUM INSULARUM sp. nov.

Maculis 2 ad 30 mm diam., sparsis, orbicularibus vel lentiner irregularibus, centro giseolis, margine angusto brunneo cinctus; acervulis amphigeneis, plerumque hypophyllis, minutis, subepidermidem, nigris, sparsis vel gregariis; conidiophoris brunneis, septatis; conidiis clavatocylindraceis, lentiner curvulis, 48 ad 85 x 3 ad 4.5 μ.

The fungus produces few scattered circular spots on the leaf. Spots 2 to 30 mm in diameter, pale yellow, with narrow reddish border and gray center (Plate 1, fig. 1). Acervuli minute, black, subepidermal, amphigenous, most frequently hypophyllous, scattered or gregarious; conidiophores brown, septate; conidia cylindroclavate, curved, nonseptate, hyaline, 48 to 85 x 3 to 4.5 μ (Plate 3, fig. 3).

LUZON, Laguna Province, College of Agriculture campus, *E. F. Roldan 38,* March 5, 1936, on living leaves of *Lansium domesticum* Correa.

This species appears to be the third of the genus reported from the Philippines, from an entirely new host. It has never been reported from *L. domesticum.*

MACROSPORIUM CENTAUREAE sp. nov.

Maculis 1 ad 15 mm diam., suborbicularibus, sparsis vel confluentibus, pallescentibus, flavis, zona rubelle-brunneis cinctus; conidiophoris amphigenis, maculicolis, brunneis, fasciculatis, subflexis, 21 ad 75 x 7 ad 7.5 μ, 3 ad 5-septatis; conidiis subclavatis, olivobrunneis, 42 ad 122 x 12 ad 17 μ, stipitatis, submuriformis, 4 ad 12-septatis.

The fungus produces spots 1 to 15 mm in diameter, irregularly circular, pale yellow, surrounded by a reddish brown border. The spots may be scattered or confluent, causing leaf blight which results in premature death of the leaves (Plate 1, fig. 3). Conidiophores maculicolous, amphigenous, fasciculate, brown, septate, subflexous, 21 to 75 x 7 to 7.5 μ, 3 to 5-septate. Conidia subclavate, olive brown, 42 to 122 x 12 to 17 μ, stipitate, submuriform, 4 to 12-septate (Plate 3, fig. 4).

LUZON, Laguna Province, College of Agriculture campus, *E. F. Roldan 41,* June 12, 1936, on living leaves of *Centaurea* sp.

The fungus appears to be recorded for the first time on this host.

HELMINTHOSPORIUM HISPANIOLAE Cif.

Helminthosporium hispaniolae CIFERRI in Estratii del Bolletino della R. Stazione di Pathologia vegetal di Roma 13 (1933) 222–308.

This fungus produces light-brown to pale straw-colored spots. At first the spots are irregularly circular, sometimes angular and limited to veins. Later they become circular. They may be scattered, or confluent and marginal. Old bottom leaves are most frequently infected (Plate 1, fig. 5). Conidiophores maculicolous, amphigenous, 0 to 3-septate, short, brownish, 14 to 74 x 3.5 to 4.5 μ; conidia cylindric, subclavate, hyaline 14.8 to 77.5 x 4.5 to 11 μ; 0 to 3-septate (Plate 3, fig. 5).

LUZON, Laguna Province, College of Agriculture campus, *E. F. Roldan 24,* September 11, 1937, on living leaves of *Manihot utilissima* Pohl.

The fungus appears to agree closely in all its important characters with Ciferri's *H. hispaniolae,* and is considered identical with it.

ISARIOPSIS CLAVISPORA (B. & C.) Sacc.

Isariopsis clavispora (B. & C.) SACC. in New Jersey Agric. Expt. Sta. Bull. 13 (1917) 144.

The fungus produces numerous chocolate-brown spots 1 to 10 mm in diameter. The spots may be scattered or confluent, causing serious leaf blight (Plate 2, fig. 1). Conidiophores brownish, slender, filiform, densely fascicled, four to several in fascicle, tops loose and wavy, 60 to 220 x 4 to 4.5 μ, 1- to 2-septate. Conidia elongate, obclavate, olivaceous, 1- to 3-septate, 33 to 76 x 6.5 to 9 μ, guttulate (Plate 4, fig. 1).

LUZON, Laguna Province, College of Agriculture campus, *E. F. Roldan 30*, September 15, 1937, on living leaves of *Vitis vinifera* Linn.

This fungus is widely distributed in the southern United States of America. It is not sure to be known in Europe. It is new to the Philippines.

ACROTHECIUM RUBIGINOSUM sp. nov.

Maculis 2 ad 20 mm latis, orbicularibus vel suborbicularibus, sparsis vel confluentibus, rubiginiis, centro atrofuscus, margin pallido flavida cinctus; conidiophoris maculiculis, hypophyllis, fuligenis, simplicibus, filiformis, fasciculatis, pluriseptatis, 45 ad 172 x 3.4 ad 4.6 μ; conidiis olivaceo-brunneis, 3-septatis, ovatis, orthotropis vel curvatis, 15 ad 27.5 x 7.5 ad 12.5 μ.

This fungus produces spots 2 to 20 mm in diameter, rusty brown, circular to subcircular. The spots, causing leaf blight, may be scattered or fused. Center of spot dark brown with light-yellow border (Plate 2, fig. 2). Conidiophores hypophyllous, maculicolous, brownish, simple, filiform, fasciculate, pluriseptate 45 to 172 x 3.4 to 4.6 μ. Conidia olive-brown, 3-septate, ovate, usually curved, sometimes straight, 15 to 27.5 x 7.5 to 12.5 μ (Plate 4, fig. 2).

LUZON, Laguna Province, College of Agriculture campus, *E. F. Roldan 53*, August 11, 1936, on living leaves of *Eurycles amboinensis* (Linn.) Lindl.

This plant appears to be listed for the first time as a host of *Acrothecium rubiginosum*.

PIRICULARIA CANNAE sp. nov.

Areis, initio sparsis dein confluentibus, irregularibus, atrofuscus, centro pallescentibus brunneis; conidiophoris hypophyllis, laxa fasciculatis 4 ad 6, lentiner brunneis, simplicibus, 60 ad 125 μ, septatis; conidiis ovato-pyriformibus, lentiner brunneis, 1- ad 2-septatis, acrogenis, scorpoidis cyme, 35 ad 49 x 14 ad 21 μ.

This fungus produces dark-brown, irregular patches, scattered at first, later merging, producing blight in the leaves of the host plant (Plate 1, fig. 2). Conidiophores hypophyllous, loosely fasciculate in clusters of 4 to 6; slightly brownish, septate, simple, 60 to 125 μ long; conidia ovate-pyriform, septate, terminal in scorpoid cyme, 1- to 2-septate, 35 to 49 x 14 to 21 μ (Plate 3, fig. 6).

LUZON, Laguna Province, College of Agriculture campus, *E. F. Roldan 43*, September 15, 1937, on living leaves of *Canna indica* Linn.

This fungus may be allied to *Piricularia grissea* (Cke.) Sacc., on grasses, but it differs from the latter in having much larger spores.

MACROPHOMA PHASEOLINA F. Tassi.

Macrophoma phaseolina F. TASSI in Foreign Plant Diseases, a manual of economic plant diseases which are new to or not widely distributed in the United States. U. S. Dept. Agric. (1926) 136.

The fungus produces light-brown, usually marginal, but extensive and irregular, patches on the leaf of the host plant (Plate 2, fig. 3). Several patches may merge, causing severe leaf blight. Pycnidia maculicolous, amphigenous, more abundant above, scattered or gregarious, brownish, membranous, subepidermal, subglobular, 55 to 163 μ in diameter, ostiolate, not rostrate, 14 to 33 μ across the ostiole. Conidia subcylindric, granular, hyaline, 18.5 to 28 x 7.5 to 11 μ (Plate 4, fig. 5).

LUZON, Laguna Province, College of Agriculture campus, *E. F. Roldan 46*, July 17, 1936, on living leaves of *Phaseolus vulgaris* Linn.

This fungus is reported as causing irregular pale-brown leaf spots of *Phaseolus ornithoppus* in Italy. More or less the same type of spot is produced on *Phaseolus vulgaris* in the Philippines. For lack of comparison with the type specimens the Philippine species is tentatively assigned to *Macrophoma phaseolina* F. Tassi.

PHYLLOSTICTA HEVEAE Zimm.

Phyllosticta heveae ZIMM. in Sylloge Fungorum 18 (1906) 223.

This fungus produces pale-brown patches at the tip or margin of the leaf, sometimes anywhere on the leaf blade. These patches have concentric zones (Plate 2, fig. 4). Pycnidia maculicolous, amphigenous, subglobular, subepidermal, erumpent, brownish, membranous, 60 to 160 μ broad, ostiolate, cells bordering ostiole dark brown, not rostrate, ostiole 15 to 20 μ across.

Spores minute, elliptic, hyaline, 5 to 7.5 x 2.3 to 3.4 μ (Plate 4, fig. 3).

LUZON, Laguna Province, College of Agriculture campus, *E. F. Roldan 50*, August 16, 1935, on living leaves of *Hevea brasiliensis* (HBK) Muell.-Arg.

This fungus is common on Para rubber, causing marginal or apical brown patches on leaves, in Java, Trinidad, Brazil, and Malaya. It is new to the Philippines.

PHYLLOSTICTA PHYTOLACCAE Cke.

Phyllosticta phytolaccae CKE. in Sylloge Fungorum 3 (1884) 57.

This fungus produces spots 1 to 10 mm in diameter, numerous, circular, pale yellow, with narrow reddish-brown border, scattered or sometimes confluent. The numerous spots produced cause premature falling of the leaves (Plate 2, fig. 5). Pycnidia epiphyllous, minute, erumpent, scattered or gregarious, brownish, membranous, ostiolate but not rostrate, 63 to 148 μ, ostiole 14.5 to 37 μ. Conidia ovoid or elliptic, hyaline, 3 to 7 x 1.5 to 2 μ (Plate 4, fig. 4).

LUZON, Laguna Province, College of Agriculture campus, *E. F. Roldan 27*, January 24, 1936, on living leaves of *Phytolacca dioica* Linn.

CICINNOBOLUS SIGACOLLUS sp. nov.

Hyphis fuscellus vel hyalinis, articulatis, erectis superficialibus; pycnidis in hyphis acropleurogenis, ovatis vel pyriformibus, minimis 48 ad 81 x 41 ad 56 μ, saepe stipitellata, membraceana, ochreo-brunneis, vertice pertusis; sporulis elliptico-oblongis vel ovatis, hyalinis, 4.5 ad 7.5 x 2.5 ad 3.5 μ.

This fungus is parasitic on the powdery mildew (Erysiphaceæ), very common on squash and other members of the Cucurbitaceæ. The fungous (*Cicinnobolus*) hyphæ intermingle with the hyphæ of Erysiphaceæ (Plate 2, fig. 6). Mycelium light brown to subhyaline, special hyphæ arising from it and bearing pycnidia which may be either acrogenous or pleurogenous. Pycnidia ovate or pyriform, 48 to 81 x 41 to 56 μ, stipitate, membraneous, ochre-brown, vertices protruding; spores elliptic or ovate-elliptic, hyaline, 4.5 to 7.5 x 2.5 to 3.5 μ (Plate 4, fig. 6).

LUZON, Laguna Province, College of Agriculture campus, *E. F. Roldan 29*, July 18, 1937, on hyphæ of Erysiphaceæ, growing on *Cucurbita maxima* Duchesne.

This fungus is allied to *Cincinnobolus cesatii* de Bary, but has larger pycnidia and pycnospores.

ILLUSTRATIONS

PLATE 1

FIG. 1. Spots on a leaf of *Lansium domesticum,* caused by *Cylindrosporium insularum* sp. nov.
2. Patches on a leaf of *Canna indica,* caused by *Piricularia cannae* sp. nov.
3. Spots on leaves of *Centaurea* sp., caused by *Macrosporium centaureae* sp. nov.
4. Patches caused by *Cercospora vaginae* Kruger on the leaf sheaths of sugar cane.
5. Spots on a leaf of cassava, caused by *Helminthosporium hispaniolae* Cif.

PLATE 2

FIG. 1. Spots on a leaf of the grape, caused by *Isariopsis clavispora* (B. & C.) Sacc.
2. Spots on a leaf of *Eurycles amboinensis,* caused by *Acrothecium rubiginosum* sp. nov.
3. Blotches on leaves of *Phaseolus vulgaris,* caused by *Macrophoma phaseolina* F. Tassi.
4. Blight at the tips of leaves of Para rubber, caused by *Phyllosticta heveae* Zimm.
5. Spots on a leaf of *Phytolacca dioica,* caused by *Phyllosticta phytolaccae* Cke.
6. Colonies of Erysiphaceæ on which *Cicinnobolus sigacollus* sp. nov. is growing.

PLATE 3

FIG. 1. Conidiophores and conidia of *Cercospora vaginae* Kruger; × 1314.
2. Conidiophores and conidia of *Cercospora fuligena* sp. nov.; × 1314.
3. An acervulus of *Cylindrosporium insularum* sp. nov. in cross section, and conidia; × 1314.
4. Conidiophores and conidia of *Macrosporium centaureae* sp. nov.; × 1314.
5. Conidiophores and conidia of *Helminthosporium hispaniolae* Cif.; × 1314.
6. Conidiophores and conidia of *Piricularia cannae* sp. nov.; × 1314.

PLATE 4

FIG. 1. Conidiophores and conidia of *Isariopsis clavispora* (B. & C.) Sacc.; × 1314.
2. Conidiophores and conidia of *Acrothecium rubiginosum* sp. nov.; × 1314.
3. Pycnidia and spores of *Phyllosticta heveae* Zimm.; × 265.
4. Pycnidia and spores of *Phyllosticta phytolaccae* Cke.; × 265.
5. Pycnidium and spores of *Macrophoma phaseolina* F. Tassi; × 1314.
6. Pycnidia and spores of *Cicinnobolus sigacollus* sp. nov.; × 1314.

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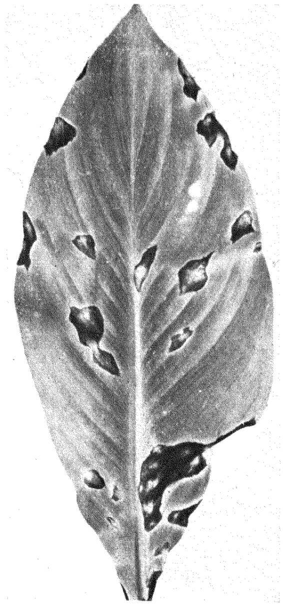

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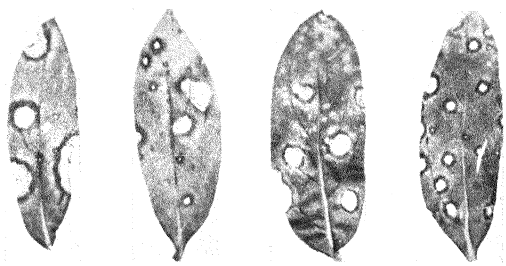

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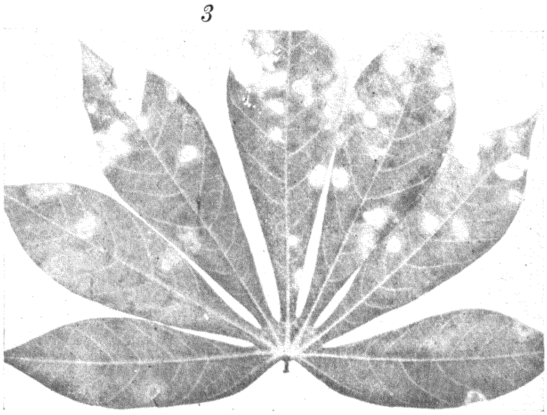

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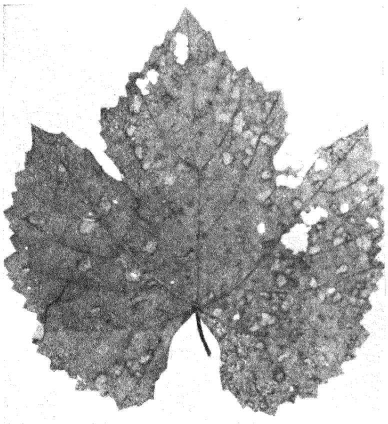
PLATE 1.



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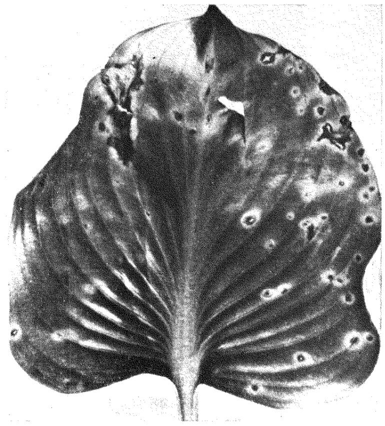

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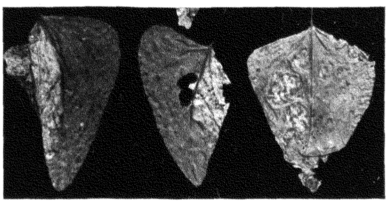

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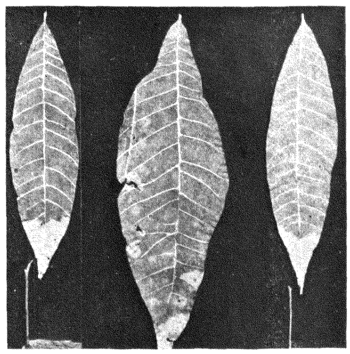

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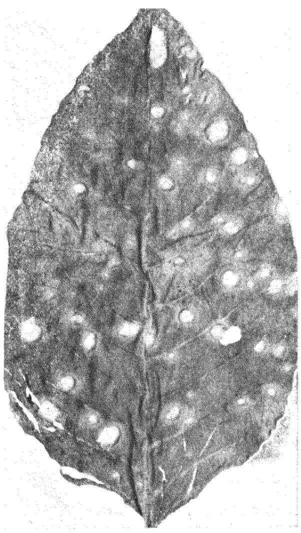

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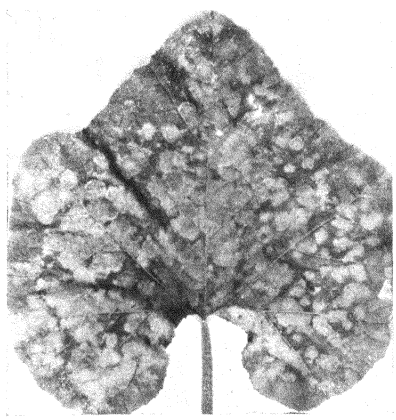

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PLATE 2.

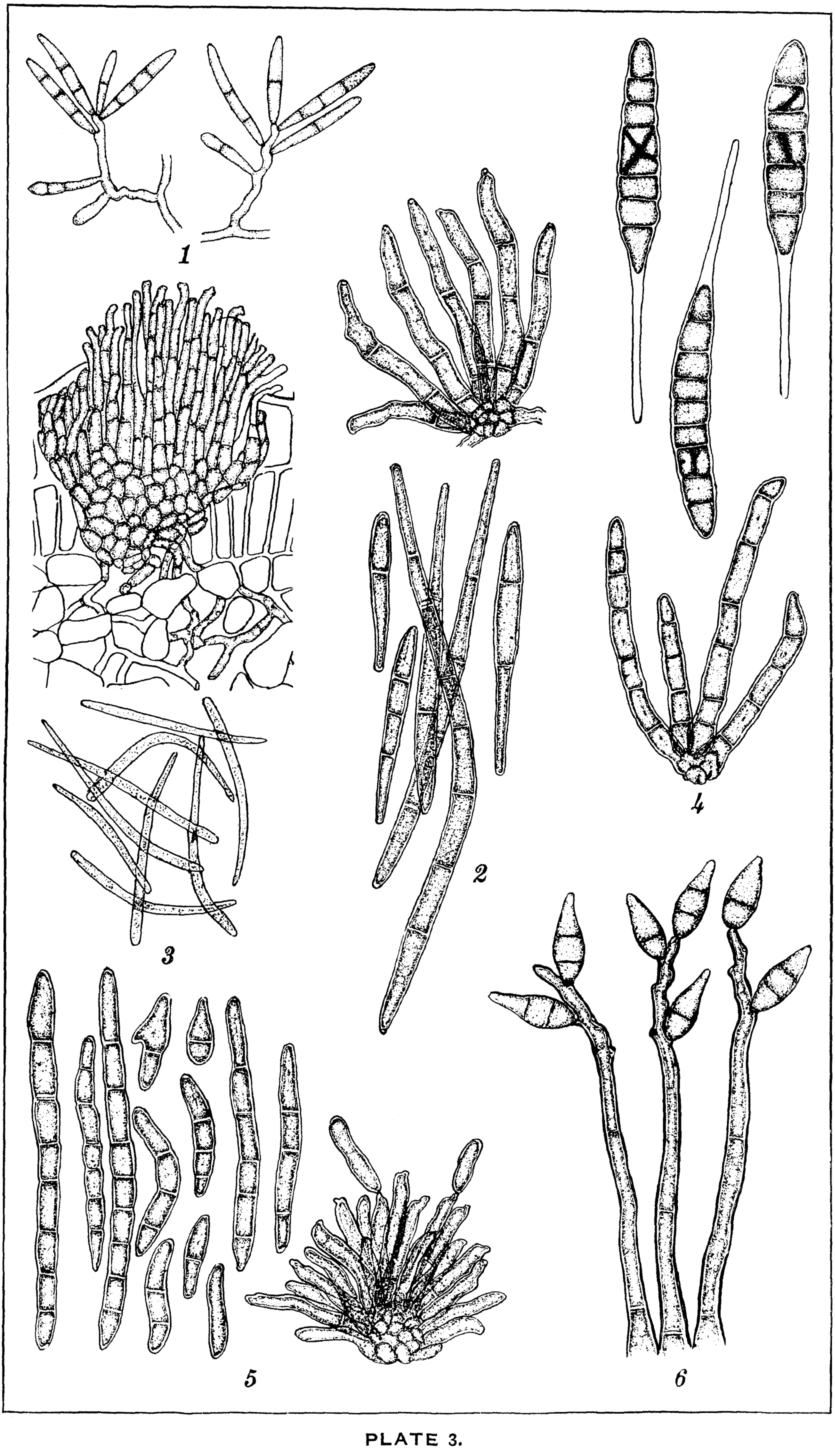

PLATE 3.

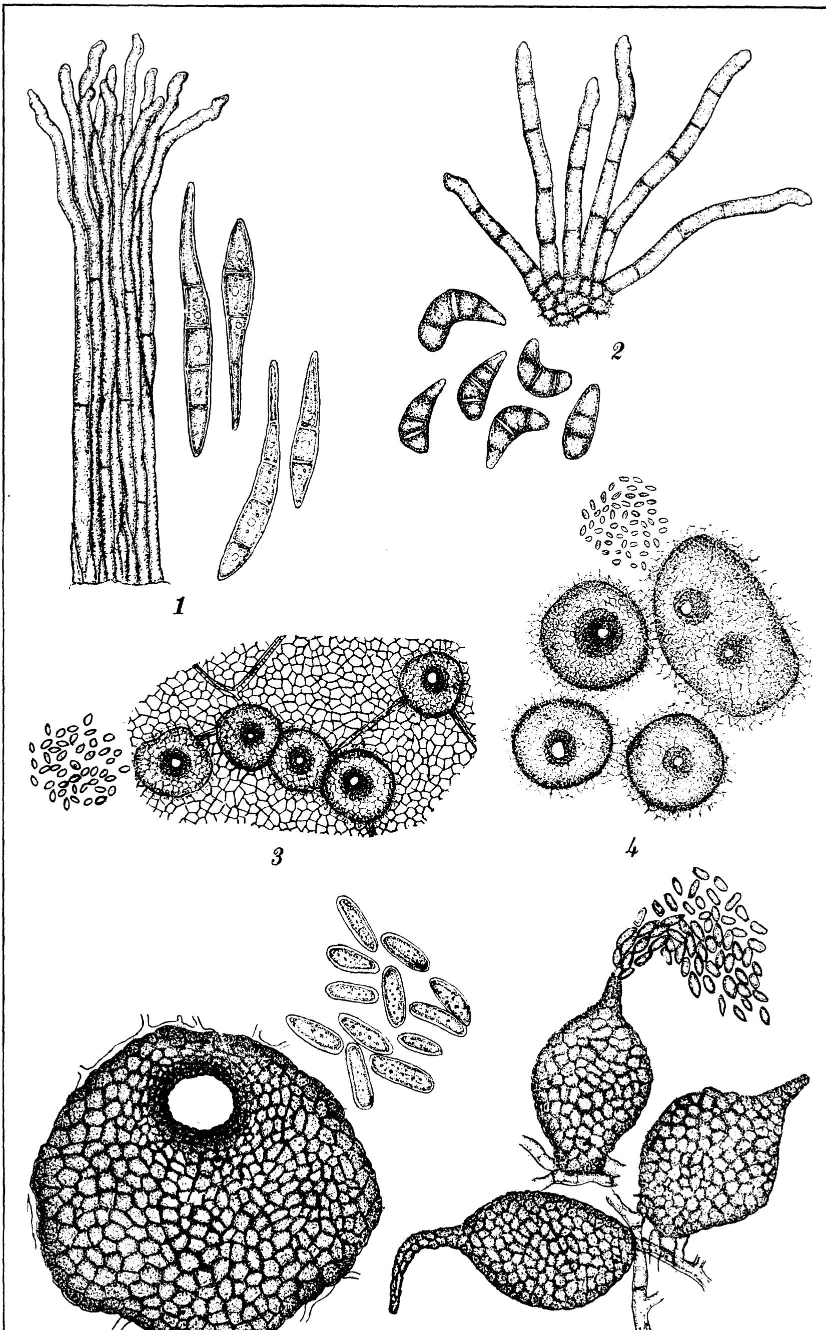

PLATE 4.

BIRDS FROM LEYTE

By Dioscoro S. Rabor
Of the Fish and Game Administration, Bureau of Science, Manila

INTRODUCTION

Information with regard to the avifauna of the Philippines is in many respects still meager or entirely lacking. Very little has been done in the study of bird distribution, local bird migrations, breeding and feeding habits, and other aspects of related nature.

Extensive collecting of birds in the various parts of the archipelago, notably in those localities which are still insufficiently worked out, will help much in the clearing up of these aspects. To this end, in May, 1937, the writer, together with an assistant, Manuel Celestino, made a collecting and observation trip in Leyte.

Leyte has been visited by few collectors, and its avifauna has not been studied as extensively as that of the contiguous island, Samar. Yet the locality has been and still is a rich field for the collecting of birds.

The earliest work on the birds of Leyte was done by Tweeddale (1878) on a collection made by Everett in 1877 in Amparo, on the southwest coast of the island. Of the 67 species he recorded, 1, *Arachnothera flammifera,* was described as new.

Ten years later the Steere Expedition visited the island, and J. B. Steere (1890) added many interesting species to the known avifauna of the locality.

John Whitehead (1896) made the third important collection in the island. He collected in the highlands of the northern part for three weeks, and then left the island due to unfavorable conditions for collection. Ogilvie-Grant (1897), working on Whitehead's Samar-Leyte collections, reported 14 species new to Leyte.

The Fleming Museum in Toronto [1] possesses a collection of birds made by Engineer J. J. Mounsey in the Philippines in 1909–10, and some of these birds are from Leyte. Nothing has been published on this collection.

[1] Hachisuka (1931) 48.

In 1932 Andres Celestino, in connection with the studies on bird parasites conducted by Dr. Marcos Tubangui, of the Bureau of Science, made a collection in the vicinity of Palo, along the northeast coast of Leyte.

The present paper sets forth the results of recent collections and observations made by M. Celestino and the writer in the highlands of this island.

Helosig, a barrio nestling among the central highlands in the southern third of Leyte, was chosen as the best collecting site. The elevation of the site and its immediate vicinities varies from 750 to 1,250 meters above sea level. The barrio is approximately midway between Baybay (west coast) and Abuyog (east coast), so that collecting and observations were also carried on at several points between these two municipalities, along the newly constructed Baybay-Abuyog road. However, collecting and observations centered mainly in Helosig and its immediate vicinity including Maitum, Nebga, Magtarao, Maangnol, Himayangan, Tagabaca, Balinsasayao, and Quarry.

The present collecting site is practically untouched virgin forest, except for the small new clearings immediately adjacent to the highway. Towards the coast are small patches of coconuts, although in general these patches cannot be found at really high elevations.

The birds collected, together with notes and observations on their habits, are given below.

The nomenclature adopted is based mainly on the following sources: Peters, J. L., Birds of the World, 2 volumes; Hachisuka, M., Birds of the Philippine Islands, 4 parts; Kuroda, N., Birds of the Island of Java, 2 volumes; Chasen, F. N., A Handlist of Malaysian Birds; McGregor, R. C., A Manual of Philippine Birds.

BIRDS COLLECTED IN LEYTE

GALLUS GALLUS GALLUS (Linnæus).

One adult male, 1 young male, and 1 female.

The juvenile specimen, almost a fledgeling, can hardly be distinguished from a domestic individual of the same age and plumage pattern. It flew about 50 meters, dodging among the tree trunks, and alighted on a branch about 7 meters from the ground.

The species is recorded for the first time from this locality.

The native name is *manok ihalas*.

TRERON POMPADORA AXILLARIS Bonaparte.

Two males and 3 females.

This species was observed feeding in flock on fruiting balete (*Ficus* sp.), together with other pigeons, as *Phapitreron amethystina amethystina, Phapitreron leucotis albifrons, Leucotreron occipitalis occipitalis,* and *Zonophaps poliocephala poliocephala.* Local hunters informed the writer that the species can be found in the mountain vicinities only from the latter part of May to September. During the other months of the year it goes to the lowlands.

The Philippine green pigeon is recorded for the first time from this island.

The native name is *punay.*

PHAPITRERON AMETHYSTINA AMETHYSTINA Bonaparte.

Ten males.

The specimens do not appreciably differ from the typical *P. a. amethystina* from Luzon. The measurements of an exceptionally large male are: Length, 313 millimeters; wing, 145; tail, 118; culmen, 26; tarsus, 19; middle toe with claw, 21.

In the forest the notes of the species are easily mistaken for the sound of a distant automobile horn.

The native name is *buro-buro.*

PHAPITRERON LEUCOTIS ALBIFRONS McGregor.

Eleven males and 12 females.

Measurements: Length, 250 millimeters; wing, 122; tail, 94; culmen, 18; tarsus, 21; middle toe with claw, 23.

A fine series of specimens of this species was secured, not differing appreciably from the typical *P. l. albifrons* from Bohol and Samar. McGregor (1909) and Hachisuka (1932) recorded the Leyte specimens as *P. l. brevirostris.* Manuel,[2] in the absence of specimens from Leyte, conjectured that the Leyte birds might be *P. l. albifrons.*

The species was commonly met with in both deep forest and second growth in the highlands and in the plains.

The native name is *limucon.*

LEUCOTRERON OCCIPITALIS OCCIPITALIS (Gray).

Five males and 4 females.

No difference exists between typical *L. o. occipitalis* from Luzon and Mindanao and the present specimens.

[2] A review of Philippine pigeons, I. The genus Phapitreron. Philip. Journ. Sci. 59 (1936) 295.

The yellow-breasted fruit pigeon was very common in the highlands. Its notes closely resemble those of its congener, *L. l. leclancheri.*

The native name is *punay.*

DUCULA ÆNEA GLAUCOCAUDA Manuel.

One female.

Measurements: Length, 400 millimeters; wing, 240; tail, 159; culmen, 25; tarsus, 29; middle toe with claw, 50.

Grant (1878) identified the Leyte form as *Carpophaga ænea* (= *Muscadivores chalybura*). Recently Manuel,[3] reviewing the Philippine forms of Duculinæ, identified the Samar form as *Ducula ænea glaucocauda.* The powdery wash on the rectrices, primaries, and secondaries is very distinct in the present specimen.

The powdery-tailed imperial pigeon was observed singly on the outskirts of forests and in second growth in the highlands. Local hunters told the writer that the species begins to come to the highlands during the latter part of May and becomes abundant in about June and July. By September it disappears from the vicinity. Undoubtedly, like *Treron pompadora axillaris,* it stays in the lowlands during the other months of the year.

The native name is *balud.*

ZONOPHAPS POLIOCEPHALA POLIOCEPHALA (Gray).

Ten males and 7 females.

Measurements: Length, 410 millimeters; wing, 209; tail, 146; culmen, 23; tarsus, 26; middle toe with claw, 48.

A nice series of this beautiful pigeon, consisting of 17 specimens of both sexes, was secured.

Hachisuka [4] recognizes 2 races of this species: *Z. p. poliocephala* for the birds from Cebu, Leyte, Luzon, Mindoro, and Panay, and *Z. p. nobilis* from Basilan, Dinagat, Masbate, Mindanao, Negros, Samar, Sibuyan, and Tawitawi. Of the newly created race he writes, "this species resembles the typical *poliocephala,* but differs in having rich metallic-bronze reflections on the neck, back and wing coverts."

The individuals in the series present no appreciable difference from typical *poliocephala* from Luzon and Mindoro; nor do they

[3] A review of Philippine pigeons, IV. Subfamily Duculinæ. Philip. Journ. Sci. 60 (1936) 410–412.

[4] Birds of the Philippine Islands 1 pt. 2 (1932) 199, 200.

show any difference from specimens of the supposed *nobilis* of Hachisuka collected from Basilan, Mindanao, Negros, and Sibuyan. The intensity of the coppery or bronze sheen in the plumage of the back presents a graduated series, varying a great deal in different specimens. Two specimens exhibited very distinctly the characteristic rich metallic bronze reflections on the neck, back, and wing coverts, a character which Hachisuka uses as a criterion for separating the South Philippine birds, as *nobilis,* from the rest. This character becomes doubtful as a basis for the formation of a new race after having been proven to be manifested in varying degrees by birds from Leyte that ought to be typical *Z. p. poliocephala.*

The species was exceptionally common in the highlands. Not infrequently as many as two dozen birds were flushed in one feeding tree at one time, feeding in company with other species of pigeons. Only in this highland site was the species observed to form rather large feeding groups.

The native name is *hagum-hum* or *agum-um.*

MACROPYGIA PHASIANELLA TENUIROSTRIS Bonaparte.

One male.

The single specimen secured was taken in the foothills near the east coast in the vicinity of Balinsasayao River. Several specimens were observed in flight in the highlands.

GALLICOLUMBA CRINIGER (Jacquinot & Pucheran).

One male.

Measurements: Length, 278 millimeters; wing, 150; tail, 98; culmen, 17; tarsus, 34; middle toe with claw, 34.

The species was very rare in the highland vicinities. The single specimen secured was flushed from the same place for two consecutive days and was taken at last on the third day, on a high ridge thickly covered with tall trees, part of a dense forest in the vicinity.

GALLINULA CHLOROPUS LOZANOI Lletget.

One female.

The moorhen was commonly seen in the small ponds that dotted the plains and the foothills near the east coast.

The native name is *itumon.*

CHARADRIUS DUBIUS DUBIUS Scopoli.

Three males.

The little ringed plover was often met with in the sandy strips of the shallow Balinsasayao River, about 10 kilometers from the coast.

ACTITIS HYPOLEUCOS (Linnæus).

One male.

The common sandpiper was secured in the same locality as the preceding species.

The species is recorded for the first time from the locality.

EGRETTA GARZETTA NIGRIPES (Temminck).

One female.

The little white egret was occasionally seen wading in the shallows of Balinsasayao River near the foothills.

The native name is *tabong.*

IXOBRYCHUS CINNAMOMEUS (Gmelin).

One female.

Several cinnamon bitterns were flushed from the tall grasses along the bank of Balinsasayao River, about 10 kilometers inland.

ACCIPITER TRIVIRGATUS TRIVIRGATUS (Temminck).

One male and 1 female.

Both specimens of the crested goshawk were secured in the highland forests near the roadside.

SPILORNIS HOLOSPILUS HOLOSPILUS (Vigors).

One male and 1 female.

Several Philippine serpent eagles were seen in the vicinity of clearings and along the roadside, usually perching on low branches of forest trees.

The native name is *sicub* or *sicup.*

HALIASTUR INDUS INTERMEDIUS Gurney.

One female.

A pair of Malayan brahminy kites were in the habit of perching on a high tree near the camp site. They preyed on the poultry in the neighborhood, and the farmers insistently requested us to shoot them. The female was taken, but the male deserted the vicinity.

The native name is *banog.*

PERNIS APIVORUS PTILORHYNCUS (Temminck).

One male.

The crested honey buzzard was rare in the vicinity. Only the specimen in the present collection was seen.

The species is recorded for the first time from the locality.

MICROHIERAX ERYTHROGENYS ERYTHROGENYS (Vigors).

One male.

Measurements: Length, 172 millimeters; wing, 110; tail, 69; culmen, 13; tarsus, 22; middle toe with claw, 22.

Comparison in measurements of the present specimen with *erythrogenys* and *meridionalis* that are in the Bureau of Science proved the Leyte bird to be *erythrogenys*. A Biliran specimen (Cat. No. 7597) collected by McGregor and A. Celestino also proved to be *erythrogenys*. It is strange that birds from Leyte and Biliran usually prove distinct from those of nearby Samar.

Leyte is a new locality for the species.

PSEUDOTYNX PHILIPPENSIS MINDANENSIS Grant.

One male (immature).

Measurements: Length, 520 millimeters; wing, 275; tail, 200; culmen, 50; tarsus, 68; middle toe with claw, 73.

The general color of the upper parts is mummy brown to blackish brown, with light ochraceous buff margins to the individual feathers. The rectrices and quills are mummy brown, with buff markings. The specimen is rather immature and in imperfect plumage. It is much darker than the typical *P. p. philippensis*.

The specimen was secured at daytime, in deep forest where it was perching on a low branch in deep shade. The horns were very distinct when the bird was excited.

The horned owl was rare in the vicinity.

The species is recorded for the first time from Leyte.

The native name is *pongao*.

OTUS BAKKAMOENA EVERETTI (Tweeddale).

One male.

Measurements: Length, 204 millimeters; wing, 155; tail, 75; culmen, 18; tarsus, 30; middle toe with claw, 30.

The single specimen of Everett's screech owl was secured near the camp site one evening.

The native name is *mingok*.

The species is recorded for the first time from the locality.

NINOX PHILIPPENSIS Bonaparte.

One male (nestling) and 1 female.

A nestling of the Philippine hawk owl was brought to the camp by a farmer, who found it in the hole of a tree which he

felled in his new clearing in the forest. The young individual stayed in the camp for about a week before it died. The characteristic distinct white spots on the outer webs of the newly-developing quills are clearly shown in the young specimen. The remaining part of the plumage is all down.

The native name is *mingok*.

PRIONITURUS DISCURUS DISCURUS (Vieillot).

Three males and 5 females.

The Philippine racket-tailed parrakeet was commonly nesting in the highlands. Nest holes are frequently seen on the trunk of tall forest trees, usually near or in clearings. As many as six couples nested in one trunk. Apparently the holes are spacious inside, for the birds were always observed to get in head first and later to turn inside with only the bill visible from the outside. Natives climb the nests with much difficulty in order to procure the young birds for pets. These birds are taught to talk.

The native name is *canauihan*.

TANYGNATHUS LUCIONENSIS LUCIONENSIS (Linnæus).

One male and 2 females.

A pair were seen nesting in the trunk of a tall tree in a clearing in the same nesting site as the preceding species. The nest hole was very similar to that of *Prioniturus*. The natives climb the nestholes of this species also, and get the young parrots for house pets.

The native name is *picoy* or *perico*.

BOLBOPSITTACUS INTERMEDIUS Salvadori.

Three males and 2 females.

The intermediate guaiabero was often seen feeding on guava shrubs in the lower altitudes, mostly in clearings or in second growth. The bird is difficult to distinguish from the leaves of the plants where it happens to perch, although it may give forth its whistling note all the while.

The native name is *koligot*.

LORICULUS PHILIPPENSIS WORCESTERI Steere.

Three males and 3 females.

Worcester's colasisi was commonly observed in the lower places of the vicinity, in both second growth and deep forest. It prefers the same type of habitat as the preceding species.

The native name is *kolansi* or *kolilising*.

BATRACHOSTOMUS SEPTIMUS SEPTIMUS Tweeddale.

One male.

Measurements: Length, 258 millimeters; wing, 160; tail, 127; culmen from base, 28; width of bill at gape, 41; tarsus, 18; middle toe with claw, 24.

The single specimen secured was one of a pair that Manuel Celestino flushed from the floor of a deep forest near a big stump. He was not able to shoot at the birds the first time they were flushed, for they suddenly disappeared in the thick growth around. He went back after two hours and flushed the pair again, from practically the same place as before. The male alighted on the nearby stump and was shot. The female disappeared in the thick growth around, and no amount of searching could flush it again. A search for the nest proved fruitless.

The present specimen very closely resembles a specimen of the same species in the Bureau of Science collection which was collected by McGregor and his party in Locquilocon, Wright, Samar.

The species was very rare in the locality.

Leyte is a new locality for the species.

EURYSTOMUS ORIENTALIS ORIENTALIS (Linnæus).

Two males and 3 females.

The broad-billed roller was very common in the highlands. It was nesting in holes made high up in the sides of the trunks of dead or alive deep-forest trees left uncut in the clearings.

The native name is *salak*.

RAMPHALCYON CAPENSIS GIGANTEA (Walden).

Two males and 1 female.

The Philippine stork-billed kingfisher was occasionally seen in both highland and lowland streams.

The native name is *bakaka*.

CEYX FLUMENICOLA Steere.

Two males and 2 females.

Steere's river kingfisher was often met with, either flying low over the water in the highland creeks or perched on some branch in dark shaded places of small streams.

CEYX SAMARENSIS Steere.

One male.

Measurements: Length, 125 millimeters; wing, 60; tail, 26; culmen, 39; tarsus, 9; middle toe with claw, 16.

The present specimen closely resembles a specimen from Wright, Samar, collected by McGregor and his party, except that the bill of the typical *samarensis* (30 millimeters) is 9 millimeters shorter than in the present specimen.

This rare kingfisher was only seen once, and very accidentally, in the regions collected in. The single specimen secured alighted close to the writer who was seated while observing bird life in deep forest and whose presence did not seem to disturb it.

The native name for all kingfishers in the place is *bakaka.*

HYDROCORAX SEMIGALEATUS (Tweeddale).

Six males, 3 adult females, and 3 young females.

The intermediate calao was very abundant in the highlands, where it was nesting during this month (May). Unlike its congener in Luzon and Mindanao, the Leyte form is not yet wary and permits close observation.

The native name is *cao.*

PENELOPIDES PANINI SAMARENSIS Steere.

Seven males and 5 females.

The Samar tarictic was abundant in the highlands.

The 7 males in the series present a great deal of variation in the size of the arrow-shaped black portion which Hachisuka[5] uses as an important criterion in differentiating the Leyte birds from those of Samar and Bohol. McGregor[6] considers the birds from the three above-mentioned localities as identical. Hachisuka[7] recognizes three distinct races of the birds in the above-mentioned localities: *P. p. samarensis* from Samar, having a broad black portion at the basal part of the tail feathers; *P. p. leytensis* from Leyte, "having small and more narrowly pointed black portion at the shaft of the tail feathers which is an intermediate character between *samarensis* and the bird from Bohol;" and *P. p. boholensis,* "having the tail feathers entirely rufous except the end, instead of having a portion of arrow shaped pattern at the basal part."

In the present series one male (rather immature) has the tail of the typical *P. p. samarensis* of Hachisuka[8] with the basal black portion almost occupying one third of the total length of the tail. On the extreme end of the series one male has the tail of the typical *boholensis* of Hachisuka in the total absence

[5] Contributions to the Birds of the Philippines (2) pt. 6 (1930) 168, 169.

[6] A manual of Philippine Birds pts. 1, 2 (1909) 337.

[7] Contributions to the Birds of Philippines (2) pt. 6 (1930) 168, 169.

[8] Birds of the Philippine Islands 2 pt. 3 (1934) 161, text fig.

of the black portion from the base of the tail. Five individuals have the intermediate condition, ranging from almost no black portion to one with the tail almost resembling the typical *samarensis* of Hachisuka. The writer is of the opinion that this character varies with age and cannot be depended upon as a basis for racial subdivision.

The native name is *taosí.*

LYNCORNIS MACROTIS MACROTIS (Vigors).

One male and 1 female.

Measurements: Male, length, 322 millimeters; wing, 254; tail, 179; culmen, 11; tarsus, 16; middle toe with claw, 27. Female, length, 324; wing, 272; tail, 172; culmen, 10; tarsus, 16; middle toe with claw, 27.

The plumage of the present specimens does not differ appreciably from that of typical Luzon and Mindanao birds.

Nightjars were occasionally observed in their crepuscular flights in the vicinity of the camp site. From their comparative size one could easily tell that two forms were found in the locality. The birds were within shooting distance and could have easily been hit, but the retrieving of the specimens presented difficulties. They always flew over densely vegetated areas, and it would have been impossible to find any bird that fell in the dense growth. However, one early evening a specimen was shot while crossing a cleared area. Another specimen flushed from its daylight bed in the forest floor was also secured.

The native name *kaó-kaó* is also given to *Caprimulgus.*

The species is recorded for the first time from the locality.

CAPRIMULGUS MACRURUS MANILENSIS Walden.

One male.

Measurements: Length, 243 millimeters; wing, 173; tail, 126; culmen, 9; tarsus, 16; middle toe with claw, 23.

The single specimen secured is in poor condition due to the rains. Comparison with specimens in the collection identified it as *C. macrurus manillensis.*

The species is recorded for the first time from the locality.

HEMIPROCNE COMATA MAJOR (Hartert).

Two males and 2 females.

Measurements: Males, length, 163, 157 millimeters; wing, 135, 127; tail, 79, 75; culmen, 5, 5; tarsus, 6, 6; middle toe with claw, 11, 11. Females, length, 167, 145; wing, 136, 125; tail, 83, 75; culmen, 5, 5; tarsus, 7, 6; middle toe with claw, 11, 11.

The present specimens do not appreciably differ from typical specimens of *H. c. major,* from Luzon, Mindoro, and Negros, nor from birds collected in Basilan and Mindanao. Hachisuka [9] recognizes three races of the species: *H. c. major, H. c. nakamurai,* and *H. c. comata.* He places the Basilan and Mindanao birds as a distinct race, *nakamurai,* differentiating them from the northern specimen by the supposedly stronger tinge of green on the back and under surface of the body, and by the measurements being intermediate between those of *major* and *comata.* The writer is of the opinion that examination of a large series of birds from the northern islands, Mindanao and Basilan, will prove *nakamurai* identical with *major.*

The species was commonly met with in the highlands.

It is recorded for the first time from the locality.

MEARNSIA PICINA (Tweeddale).

One male and 1 female.

Measurements: Male, wing, 170 millimeters; tail, 33; culmen, 5; tarsus, 10; middle toe with claw, 14. Female, wing, 177; tail, 34; culmen, 5; tarsus, 10; middle toe with claw, 14.

Tweeddale's spine-tailed swift is one of the rarest birds. Hachisuka [10] writes of this species ". . . *Chaetura picina* rarest of rare birds . . . Altogether only nine specimens of this genus are recorded."

Many big swifts were seen flying around the camp site, but always beyond shotgun range. One rainy day one of them was luckily brought down, and proved to be of the present species. The next day another was added to the collection.

The species is not rare in the highland regions collected in, scores of them being visible in high flight at any time of day; securing them, however, is quite difficult.

HARPACTES ARDENS (Temminck).

One male and 2 females.

This beautiful bird was frequently seen in the deep forests of the highlands.

SURNICULUS LUGUBRIS VELUTINUS Sharpe.

One male.

Measurements: Length, 208 millimeters; wing, 118; tail, 110; culmen, 20; tarsus, 16; middle toe with claw, 20.

[9] Tom. cit., 172, 173.

[10] Birds from the Philippine Islands 1 pt. 1 (1931) 24; 2 pt. 3 (1934) 187.

The Philippine drongo cuckoo was rare in the highlands. The single specimen secured was shot in a thick growth bordering a new clearing.

The species has never before been recorded from Leyte.

HIEROCOCCYX SPARVERIOIDES (Vigors).

One female.

Measurements: Length, 322 millimeters; wing, 190; tail, 162; culmen, 30; tarsus, 20; middle toe with claw, 30.

The present specimen is indistinguishable from the typical *H. sparverioides* in the collection.

The Asiatic hawk cuckoo was very rare in the locality. The single specimen secured was the only individual seen in the site.

The species has been recorded only from Calamianes, Luzon, and Negros.

Leyte is a new locality for it.

CUCULUS CANORUS TELEPHONUS Cabanis and Heine.

One female.

Measurements: Length, 320 millimeters; wing, 207; tail, 168; culmen, 23; tarsus, 17; middle toe with claw, 28.

Like the preceding species, the European cuckoo has been recorded only from a few localities—Basilan, Batan, Calayan, Palawan, and Siquijor.

It was very rare in the highland regions covered.

It is recorded for the first time from Leyte.

CENTROPUS VIRIDIS (Scopoli).

One male.

The red-winged coucal was not seen at all in the highlands. However, it was common in the second growth of the foothills and the lowlands.

The native name is *ko-kok*.

CENTROPUS MELANOPS Lesson.

Two males.

The black-eyed coucal was often met with in the highlands, usually in thick growth near or in clearings.

The native name is *abunog*.

CHRYSOCOLAPTES LUCIDUS RUFOPUNCTATUS Hargitt.

Three males and 6 females.

The red-spotted golden flicker was often seen on the outskirts of deep forests which bordered clearings. It was also occasionally seen in deep woods.

The native name is *bala-latok* or *batok*, a name also given to the other species of woodpecker.

LICHTENSTEINIPICUS FULIGINOSUS (Tweeddale).

Two males and 1 female.

The sooty woodpecker was seldom met with in the highlands. All the three specimens secured were collected in very deep forest far from clearings.

THRIPONAX PECTORALIS Tweeddale.

Six males and 4 females.

This species was commonly found in both deep forest and clearings. Three individuals were observed feeding on an ant colony in a dead trunk in a clearing.

SARCOPHANOPS SAMARENSIS Steere.

Two males and 1 female.

Measurements: Males, length, 145, 150 millimeters; wing, 77, 78; tail, 54, 55; culmen, 20, 20; tarsus, 20, 21; middle toe with claw, 21, 21. Female, length, 149; wing, 77; tail, 56; culmen, 20; tarsus, 20; middle toe with claw, 21.

The Leyte specimens are indistinguishable from typical *S. samarensis* of Samar. The species is rare in the highlands. Five individuals, apparently belonging to one feeding group, were seen in deep forest; three of them were secured while the others disappeared in the thick growth.

HYPOTHYMIS AZUREA AZUREA (Boddaert).

One male.

The black-naped flycatcher was commonly met with in second growth and occasionally in the forest.

RHIPIDURA SUPERCILIARIS SAMARENSIS (Steere).

Two males and 1 female.

The Samar blue fantail flycatcher was often met with in company in thick growth in the forest.

RHINOMYIAS RUFICAUDA MINDANENSIS Mearns.

One male.

Measurements: Length, 145 millimeters; wing, 81; tail, 66; culmen, 15; tarsus, 17; middle toe with claw, 17.

The present specimen is indistinguishable from typical *R. r. mindanensis* from Mindanao. It is appreciably bigger than any of the *R. r. samarensis* in the collection of the Bureau of Science from Samar. Hachisuka (1935) considers the Samar,

Leyte, and Mindanao forms as belonging to one race, *R. r. samarensis*.

The species is very rare in the highlands.

CORACINA STRIATA KOCHI (Kutter).

One male and 2 females.

Koch's barred cuckoo shrikes were frequently met with in tall trees in deep forest near clearings. Occasionally individuals invaded the clearings where they were easily secured.

IRENA ELLÆ Steere.

One male and 2 females.

Ella's fairy bluebirds were not scarce in the deep forests of the highlands, but they were often mistaken for *Dicrurus*.

IOLE EVERETTI (Tweeddale).

Three males and 2 females.

The species was commonly met with on the outskirts of deep forest and second growth, especially near river banks.

IOLE PHILIPPENSIS PHILIPPENSIS (Gmelin).

Two males and 1 female.

The Philippine bulbul was commonly observed in second growth and in clearings.

The native name is *paragó* or *palagó*.

PYCNONOTUS GOIAVIER GOIAVIER (Scopoli).

One male.

The guava bulbul was often seen in clearings and second growth, both in the highlands and in the lowlands.

The native name of this species also is *paragó* or *palagó*.

PTILOCICHLA MINUTA Bourns and Worcester.

One female.

Measurements: Length, 128 millimeters; wing, 64; tail, 42; culmen, 16; tarsus, 25; middle toe with claw, 21.

The present specimen is indistinguishable from typical *P. minuta* from Wright, Samar.

The lesser ground babbler is not at all rare in the highlands. Several specimens were seen in very thick undergrowth in deep forest, but they were very difficult to secure.

MACRONOUS STRIATICEPS MINDANENSIS Steere.

One male and 3 females.

The present specimens do not show any difference from typical *M. s. mindanensis* from Mindanao.

The Mindanao tit babbler was often seen in groups of several individuals on the forest floor, and in thick second growth.

ORTHOTOMUS FRONTALIS Sharpe.

One male and 1 female.

Sharpe's tailorbird was commonly seen and heard in thick growth around clearings.

MEGALURUS PALUSTRIS FORBESI Bangs.

One female.

The striated marsh warbler was never observed in the highlands, but it was common in the lowlands near the coast.

The species is recorded for the first time in Leyte.

ARTAMUS LEUCORHYNCHUS LEUCORHYNCHUS (Linnæus).

One female.

The white-bellied swallow shrike was rarely seen in the highlands, but was common in the lowlands.

The native name is *it-it.*

HYLOTERPE APOENSIS Mearns.

One female.

This thickhead was scarce in the highlands. Only the single specimen secured was seen. It was taken in deep forest.

CALLISITTA FRONTALIS LILACEA (Whitehead).

One female.

The lilac-faced nuthatch was seen but once in the highlands. A pair was seen climbing round and round the trunk of a very tall forest tree in deep forest, well beyond gun range. The female luckily moved to a lower perch and was secured.

ZOSTEROPS PALPEBROSA BASILANICA Steere.

Three females.

Steere's silvereye was often met with in small groups in second growth.

DICÆUM CINEREIGULARE Tweeddale.

Three males.

The ashy-chinned flowerpecker was common in second growth and in the standing vegetation of clearings.

DICÆUM EVERETTI Tweeddale.

One male.

Measurements: Length, 82 millimeters; wing, 50; tail, 28; culmen, 12; tarsus, 12; middle toe with claw, 14.

Everett's flowerpecker was met with only once in the highlands, feeding on a low fruiting tree in deep forest in company with *Prionochilus inexpectatus*.

PRIONOCHILUS OLIVACEUS Tweeddale.

One male.

Measurements: Length, 87 millimeters; wing, 53; tail, 28; culmen, 10; tarsus, 12; middle toe with claw, 13.

The present specimen is indistinguishable from typical *P. olivaceus* from Samar. The single specimen secured was seen feeding on a fruiting bush in deep forest together with several *P. inexpectatus*. Apparently the species is rare in the vicinity.

PRIONOCHILUS INEXPECTATUS Hartert.

Two males and 1 female.

Hartert's flowerpecker was rather common in the highlands.

ÆTHOPYGA BELLA Tweeddale.

Two males and 2 females.

Measurements: Length, 77 millimeters; wing, 40; tail, 30; culmen, 12; tarsus, 12; middle toe with claw, 12.

Tweeddale's sunbird was commonly seen in coconut groves in highland clearings, and in second growth.

Whitehead collected the species in Samar. It is recorded from Leyte for the first time.

EUDREPANIS PULCHERRIMA (Sharpe).

One male.

Measurements: Length, 78 millimeters; wing, 48; tail, 26; culmen, 18; tarsus, 14; middle toe with claw, 13.

The Mindanao sunbird was only seen once in the highlands, emerging from a thick bush by the roadside. Apparently it is rare in the highlands.

LEPTOCOMA BRAZILIANA SPERATA (Linnæus).

One male.

The red-breasted sunbird was common in coconut groves in the same vicinity as *Æthopyga bella*. Oftentimes these two specimens were seen feeding on coconut flowers on the same tree at the same time.

ANTHREPTES MALACCENSIS GRISEIGULARIS Tweeddale.

Two males and 3 females.

Measurements: Length, 104 millimeters; wing, 60; tail, 40; culmen, 16; tarsus, 15; middle toe with claw, 16.

The present specimens are indistinguishable from typical *A. m. griseigularis* from Samar.

The gray-throated sunbird was often observed in coconut groves, feeding on the insects attracted by the coconut flowers.

The species is recorded for the first time from Leyte.

ARACHNOTHERA PHILIPPINENSIS (Steere).

One female.

Measurements: Length, 150 millimeters; wing, 85; tail, 45; culmen, 38; tarsus, 18; middle toe with claw, 18.

The naked-faced spider hunter was seen only once in the highlands. The only specimen secured was shot in dark dense growth at the side of a creek.

UROLONCHA LEUCOGASTRA EVERETTI (Tweeddale).

One female.

Everett's weaver was commonly met with in flock, feeding on the patches of mountain rice in the highlands. The species was just as abundant in the highlands as the Philippine weaver, *Munia atricapilla minuta.*

The native name is *maya.*

ORIOLUS CHINENSIS CHINENSIS Linnæus.

One male and 1 female.

The Philippine oriole was a very common bird at low altitudes.

ORIOLUS XANTHONOTUS SAMARENSIS Steere.

One male.

Measurements: Length, 203 millimeters; wing, 118; tail, 87; culmen, 24; tarsus, 22; middle toe with claw, 22.

The Samar oriole was very rare in the vicinity. The single specimen secured was shot from a high forest tree by the roadside.

Whitehead (Grant, 1897) writes of the species, "This species, according to my experience, was extremely rare in both islands, . . ."

DICRURUS HOTTENTOTTUS STRIATUS Tweeddale.

Three males and 5 females.

The southern drongo was commonly met with in both deep forest and second growth. The native hunters believe that the bird invariably follows in the wake of feeding monkey groups. They believe in a very close relationship between the bird and the monkey.

The native name is *agad-agad* or *uwak-uwak.*

SARCOPS MELANONOTUS Grant.

One male and 1 female.

The black-backed coleto was very common in the highlands and in the lowlands near the hills.

The native name is *iling*.

Two hundred and fifty-seven specimens were collected, belonging to 77 forms, 17 being recorded for the first time from the locality.

The following species were observed in the highland vicinities but not collected: *Megapodius* sp., *Chalcophaps indica indica* Linnæus, *Rallus torquatus torquatus* Linnæus, *Poliolimnas cinereus* (Vieillot), *Collocalia* sp., *Pitta sordida sordida* (P. L. S. Müller), *Pericrocotus flammeus leytensis* Steere, and *Poliolophus urostictus urostictus* (Salvadori). Three of the forms observed, *Megapodius* sp., *Chalcophaps indica indica,* and *Pitta sordida sordida,* are recorded for the first time from the locality. A total of 20 forms will have been recorded as new to the locality if the 3 species which were observed but not collected be included.

The forms collected from Leyte have been recorded from Samar, except the following 6: *Pseudotynx philippensis mindanensis, Lyncornis macrotis macrotis, Caprimulgus macrurus manillensis, Mearnsia picina, Hierococcyx sparverioides,* and *Cuculus canorus.* In general the avifauna of Leyte and Samar is very similar.

SUMMARY AND CONCLUSIONS

In May, 1937, the writer, accompanied by Manuel Celestino, made a collection and observation of birds in Leyte, in order to obtain data which may aid in the solution of such important ornithological problems as bird distribution, local bird migrations, and breeding and feeding habits.

Collections and observations were carried on in the vicinity of Helosig, a highland barrio in the central highlands of the southern third of Leyte. Two hundred and fifty-seven specimens, belonging to 77 forms, were collected. Eight forms were observed but not collected. Seventeen forms of those collected, and 3 of those observed, are newly recorded from the locality.

All but 6 forms collected in Leyte have been recorded from Samar. In general there is a very close relationship between the avifauna of Leyte and that of Samar.

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FIVE OTHER KNOWN SPECIES OF PENÆUS IN THE PHILIPPINES

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FOUR PLATES

Blanco and Arriola (1937) were the first to attempt a systematic study of some known species of Philippine Penæidæ in a single paper. They described five species, *Penæus canaliculatus* Olivier, *Penæus affinis* Milne-Edwards, *Penæus incisipes* Spence Bate, *Penæus indicus* Milne-Edwards, and *Penæus monodon* Fabricius. Five other species are of economic importance; namely, *Penæus indicus* var. *longirostris* de Man, *Penæus canaliculatus* var. *japonicus* Spence Bate, *Penæus anchoralis* Spence Bate, *Penæus monodon* var. *manillensis* var. nov., and *Penæus rectacutus* Spence Bate. These have not heretofore been reported or described from the Philippines. *Penæus monodon* is locally known as *sugpo*, and all the other species as *hipon suahe*. The present study brings the systematics of Philippine shrimps of the genus *Penæus* up to date, and also gives the taxonomy and morphology of these crustaceans.

The body of a *Penæus* may be divided into two general parts, the cephalothorax and the abdomen. The cephalothorax represents a fusion of the head and thorax, and is covered dorsally and laterally by the carapace. Arising from the midanterior margin of the carapace is a straight rostrum, which is elevated dorsally but compressed laterally into a crest. It is armed dorsally with spines, ranging in number from 6 to 12, and ventrally with 0 to 5 spines $\left\{\frac{6\text{–}12}{0\text{–}5}\right\}$.

On either side of the carapace near the anterior margin are two teeth the anterior of which is the first antennal tooth, and the posterior, the hepatic tooth. At the anterior margin of the carapace, on each side of the base of the rostrum, is an eye mounted on a stalk. Below the eye is the hollow peduncle of the first antenna, which bears a bifurcate flagellum. Immediately beneath the peduncle is a scalelike structure, the antennal

scale or scaphocerite of the second pair of antennæ. From the base of this scale at its ventral side arises the whiplike flagellum of the second antenna.

On the ventral side of the cephalothorax are five pairs of legs, the pereiopods. The first three pairs are provided with pincers. Each of these legs are made up of several segments, the ischiopodite, the carpopodite, and the propodite, the latter giving rise to the immobile finger of the pincers. The other part of the pincer is movable, and is known as the mobile finger. The last two pairs of pereiopods do not possess pincers, but have the dactylopodites instead. All of these appendages are connected to the cephalothorax by two very short segments, the coxopodite and the protopodite.

The buccal cavity is bordered by the following oral appendages: A pair of mandibles; the first and second pairs of maxillæ; and the first, second, and third pairs of maxillipeds, which are in reality thoracic appendages performing functions of an oral appendage. At the mouth region are two other structures that might be mistaken for true limbs but which do not belong to the same category. At the anterior border of the buccal aperture is a much thickened upper lip, the labrum situated just in front of the well-developed mandibles. The lower lip, which has two lobes, the pragnatha, appearing like true appendages, adheres to the posterior surface of the mandibles.

The abdomen is made up of six ordinary segments and one terminal pointed telson grooved on its middorsal surface. All the abdominal somites are covered with a tough exoskeleton, the dorsal surface of each and part of the lateral sides of which are designated as the tergum, and the lower part of the lateral sides, the pleuron. Attached to the sides of each of the first five somites at the ventral surface of the abdomen is a pair of swimmerets or pleopods. The sixth somite possesses longer and broader appendages, the uropods, which together with the telson form the tail fan.

The male is differentiated from the female by the presence of the petasma, a membranous development of the endopodites of the first pair of its pleopods. The male genital opening is situated at the coxopodites of the fifth pair of pereiopods. The female, on the other hand, has its sternum divided longitudinally into a median cleft, immediately between the fifth pair of pereiopods. The sides of this cleft appear as flattened calcified plates, called the thelycum. This structure extends from the base of the coxopodites of the fourth pair of pereiopods to

the posterior border of the sternum. The female genital opening is located on the coxopodites of the third pair of pereiopods. The exopodite of the first pair of pleopods is long and flat, while the endopodite is less developed, appearing like a small bud.

PENÆIDÆ

Body laterally compressed. Carapace well developed, passing beneath anterior border of coxal plates of first segment of abdomen. Rostrum usually long, laterally compressed, and mostly strengthened on sides by a longitudinal ridge; teeth generally numerous. Antennules with two flagella. Mandible large and powerful with an incisive external margin, with palp of one or two segments. Five pairs of pereiopods present, first three pairs slender and chelate; last two pairs with dactylopodites.

Genus PENÆUS Fabricius

Body laterally compressed up to posteriormost somite. Carapace armed with a laterally compressed rostrum, more or less toothed or fringed with tiny hairs. Eyes large and ovate, supported by two-jointed stalks. Antennæ with two flagella shorter than carapace. Antennules with a large scaphocerite toothed on its outer margin, foliaceous and thin on inner margin. Mandibles large and strong, with large and foliaceous two-jointed palps. First three pairs of pereiopods chelate; last two pairs terminate in dactylopodites. Pleopods large, with two foliaceous branches in all pairs except first pair which exhibits characters for sexual dimorphism.

Key to the Philippine species of Penæus.

a^1. Lateral rostral sulci extending to posterior margin of carapace, ventral rostral tooth opposite anterior rostral tooth.

b^1. Telson without spinules on lateral margin. Rostral formula $\frac{9\text{–}10\text{–}11}{1}$.

Penæus canaliculatus Olivier.

b^2. Telson armed with three small spines on lateral margin. Rostral formula $\frac{11\text{–}12\text{–}13}{1}$ ....*Penæus canaliculatus* var. *japonicus* Spence Bate.

a^2. Lateral rostral sulci not extending to posterior margin of carapace, ventral rostral tooth either absent or present.

b^1. Rostrum without crest, ventral margin without teeth.

c^1. Telson without spines.

d^1. Rostral formula $\frac{9\text{–}11}{0}$; rostrum slightly turned upward on tip.

Penæus affinis Milne-Edwards.

d^2. Rostral formula $\frac{8\text{–}9\text{–}10\text{–}11}{0}$; rostrum narrow and straight.
Penæus incisipes Spence Bate.

c^2. Telson with spines.

d^1. Rostral formula $\frac{8\text{–}10}{0}$; 1 tooth on gastric region. Telson armed with one small spine on lateral margin.
Penæus anchoralis Spence Bate.

d^2. Rostral formula $\frac{9}{0}$; one tooth on gastric region. Telson armed with two small spines on lateral margin.
Penæus rectacutus Spence Bate.

b^2. Rostrum with crest.

c^1. Ventral margin with teeth.

d^1. Rostrum distinctly curved upward. Rostral formula $\frac{7\text{–}8}{5}$. Rostrum projects beyond antennal scales by one-third to two-fifths of free portion.... *Penæus indicus* var. *longirostris* de Man.

d^2. Rostrum straight.

e^1. Rostral formula $\frac{7\text{–}8}{4\text{–}5}$................*Penæus indicus* Milne-Edwards.

e^2. Rostral formula $\frac{6\text{–}7}{3}$...........................*Penæus monodon* Fabricius.

c^2. Ventral margin without teeth. Rostrum short, extending as far as middle of second joint of antennal peduncle. Rostral formula $\frac{6}{0}$.................................. *Penæus monodon* var. *manillensis* var. nov.

PENÆUS CANALICULATUS var. JAPONICUS Spence Bate. Plate 1, figs. 1, 2, 4, and 5.

Penæus canaliculatus var. *japonicus* SPENCE BATE, Challenger Report, Macrura (1888) 245, pls. 31, 32, 37; ALCOCK, Ann. & Mag. Nat. Hist. 14 (1905) 514.

Penæus canaliculatus ORTMANN, Zool. Jahrb. Abth. f. Syst. 5 (1890) 448, pl. 36, figs. 2*a*, *b*[1]; KISHINOUYE, Journ. Fish. Bur. 8 (1) (1900) 6, 11, pls. 1, 7, figs. 1, 1*a–c;* RATHBUN, Proc. U. S. Nat. Mus. 26 (1902) 37; ALCOCK, Cat. Indian Decap. Crust. pt. 3, Macrura, Fasc. 1 (1906) 14, pl. 2, figs. 6*a–c*.

Penæus japonicus NOBILI, Annal. Science Natur. IX 4 (1906) 10; DE MAN, Decapoda Siboga Exped. pt. 1 (1911) 107.

Rostrum as long as penultimate joint of antennular peduncle. Rostral formula $\frac{12}{1}$, all teeth lined with hairs. Five teeth on carapace. Postrostral carina longitudinally grooved. Lateral grooves very distinct, extending to posterior border of carapace. Two last segments of abdomen laterally compressed and dorsally keeled. Posterior end of sixth somite toothed. Telson armed

[1] Not in Scientific Library, Philippine Bureau of Science.

with three small spines on lateral margin, dorsally grooved and apex acuminate.

Description based on a female specimen, 111 millimeters long from anterior border of carapace to posterior end of telson.

Eighteen specimens, 56 to 111 millimeters long.

Locality.—Manila Bay (*G. A. Lopez*); BANTAYAN, Cebu Province, Bantayan (*G. A. Lopez*).

PENÆUS INDICUS var. LONGIROSTRIS de Man. Plate 2, fig. 1.

Penæus indicus var. *longirostris* DE MAN, Siboga Exped. Decapoda 55 pt. 1 (1911) 103–4; ALCOCK, Cat. Indian Decap. Crust. pt. 3, Macrura, Fasc. 1 (1906) 12.

Rostrum curved upward, projecting $\frac{1}{3}$ of free portion beyond antennal scales. Rostral formula $\frac{7}{5}$. Three teeth present on carapace. Rostral crest typical. Grooves on either side of rostrum ending besides first epigastric tooth. Telson acuminate, dorsally grooved, lateral sides fringed with hairs.

Description based on a male specimen 93 millimeters long, from anterior border of carapace to posterior end of telson.

Seven specimens 65 to 121 millimeters long.

Locality.—Manila Bay (*Aldaba and Talavera*); PANAY, Iloilo Province, La Paz (*Mendoza*); NEGROS, Oriental Negros Province, Ibanhay.

PENÆUS ANCHORALIS Spence Bate. Plate 3, fig. 2.

Penæus anchoralis SPENCE BATE, Rept. Voy. Challenger, Zoöl. 24 (1873–76) 258, pl. 35, fig. 1.

Rostrum without crest, ventral margin without teeth. Rostral formula $\frac{8\text{–}10}{0}$; one tooth on gastric region. Third and succeeding segments of abdomen carinated, sixth ending in a small tooth. Telson longitudinally grooved and pointed, armed with one small spine on lateral margin.

Description based on a female specimen 81 millimeters long from anterior border of carapace to posterior end of telson.

Locality.—Manila Bay (*A. Seale*).

PENÆUS MONODON var. MANILLENSIS var. nov. Plate 3, fig. 1.

Rostrum with crest, ventral margin without teeth. Rostral formula $\frac{6}{0}$. Last two segments of abdomen carinated. Telson longitudinally grooved, lateral margin fringed with hairs.

This variety differs from the type species in the following points: (*a*) Dorsal surface of rostrum armed with 6 spines, the two anteriormost minute; ventral surface smooth; (*b*) rostrum short, reaching as far as middle of second joint of antennal peduncle.

Description based on a female specimen 195 millimeters long from anterior border of carapace to posterior end of telson.

Type variety bears accession number 200, Fish and Game Administration, Bureau of Science.

Locality.—Manila Bay.

PENÆUS RECTACUTUS Spence Bate. Plate 3, fig. 3.

Penæus rectacutus SPENCE BATE, Rept. Voy. Challenger, Zoöl. 24 (1873–76) 266, pl. 36, fig. 2.

Metapenæus rectacutus ALCOCK and HENDERSON, Journ. Asiat. Soc. Bengal 63 (1894) 145.

Parapenæus rectacutus DE MAN, Decapoda, Siboga Exped. 55 (1911) 82; BALSS, Macrura, Deutsche Tiefsee Exped. 2 (1925) 228.

Rostrum horizontal, straight and pointed. Ventral margin hairy. Rostral formula $\frac{9}{0}$; one tooth on gastric region. Posterior end of fourth and fifth somites slightly cleft on median line. Sixth somite twice the length of the fifth and ending in a small tooth. Telson with two small spines on each side.

Description based on a female specimen 65 millimeters long from anterior border of carapace to posterior end of telson. It bears accession number 0–216, Zoölogy Department, University of the Philippines.

ILLUSTRATIONS

PLATE 1

FIG. 1. *Penæus canaliculatus* var. *japonicus* Spence Bate; lateral view of head, natural size.

2. *Penæus canaliculatus* var. *japonicus* Spence Bate; dorsal view of telson and uropods, natural size.

3. *Penæus canaliculatus* Olivier; dorsal view of telson and uropods, natural size.

4. *Penæus canaliculatus* var. *japonicus* Spence Bate; ventral side of a male showing the petasma.

5. *Penæus canaliculatus* var. *japonicus* Spence Bate; ventral side of a female showing the thelycum.

PLATE 2

FIG. 1. *Penæus indicus* var. *longirostris* de Man; lateral view of head, natural size.

2. *Penæus indicus* Milne-Edwards; lateral view of head, natural size.

PLATE 3

FIG. 1. *Penæus monodon* var. *manillensis* var. nov., lateral view of head, natural size.

2. *Penæus anchoralis* Spence Bate; natural size.

3. *Penæus rectacutus* Spence Bate; natural size.

PLATE 4

Diagrammatic drawing of a *Penæus*. *ant*, Antennule; *sca*, scaphocerite; *a*, antenna; *e*, eye; *r*, rostrum; *c*, carapace; *ab*, abdomen; *s*, somite; *t*, telson; *u*, uropod; *pl*, pleopod; *pr*, pereiopod.

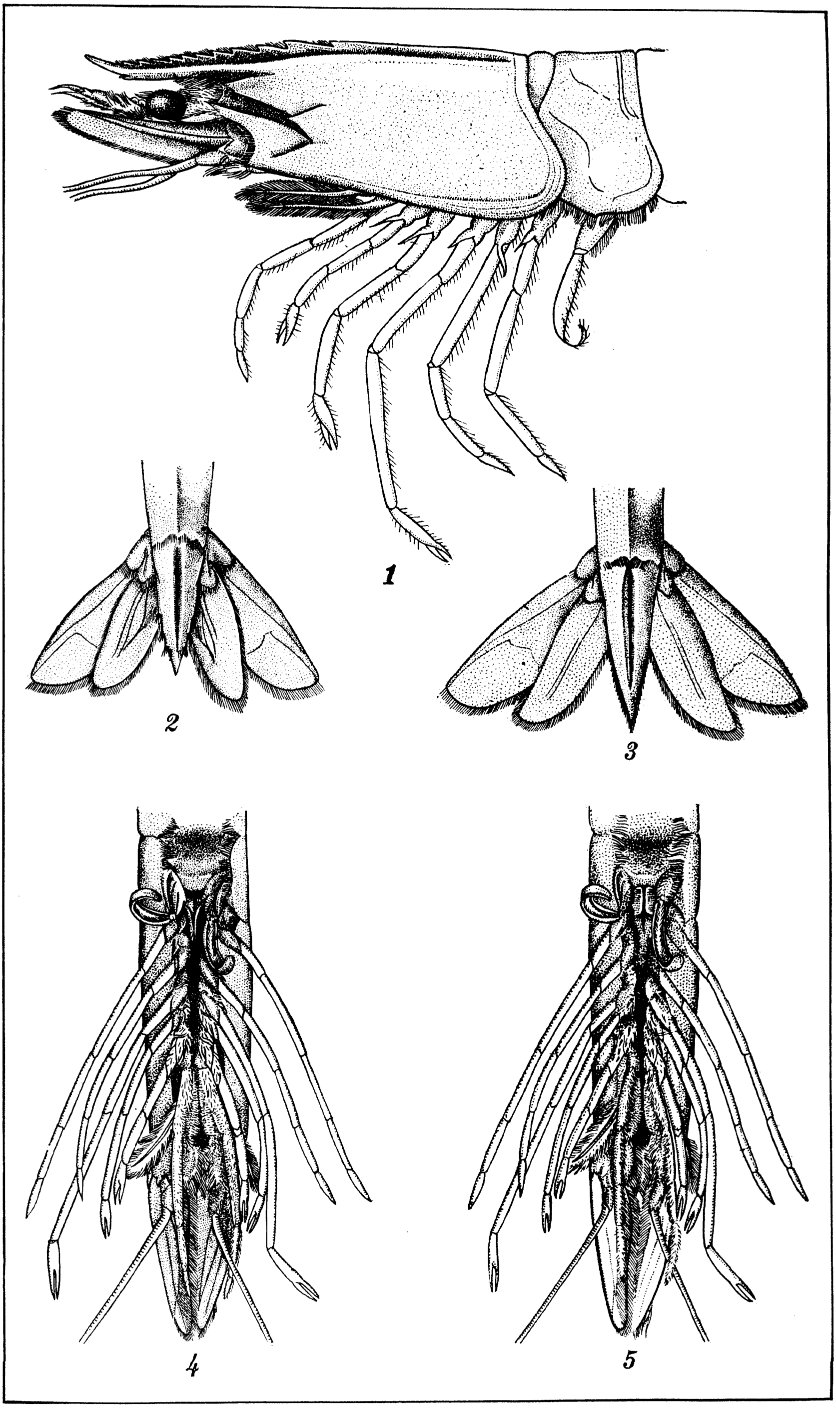
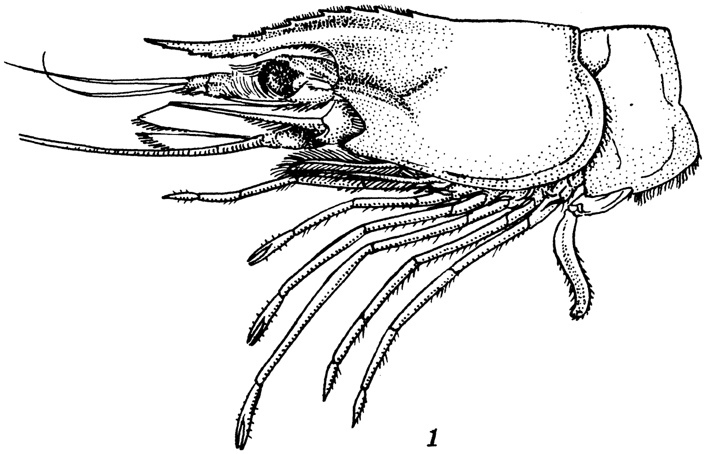


PLATE 1.



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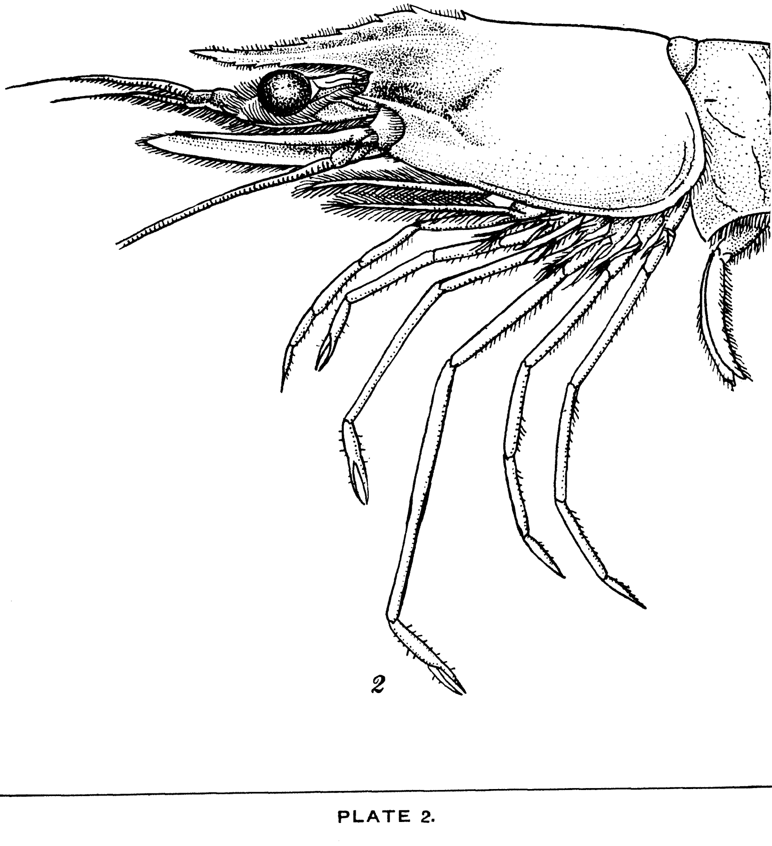

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PLATE 2.

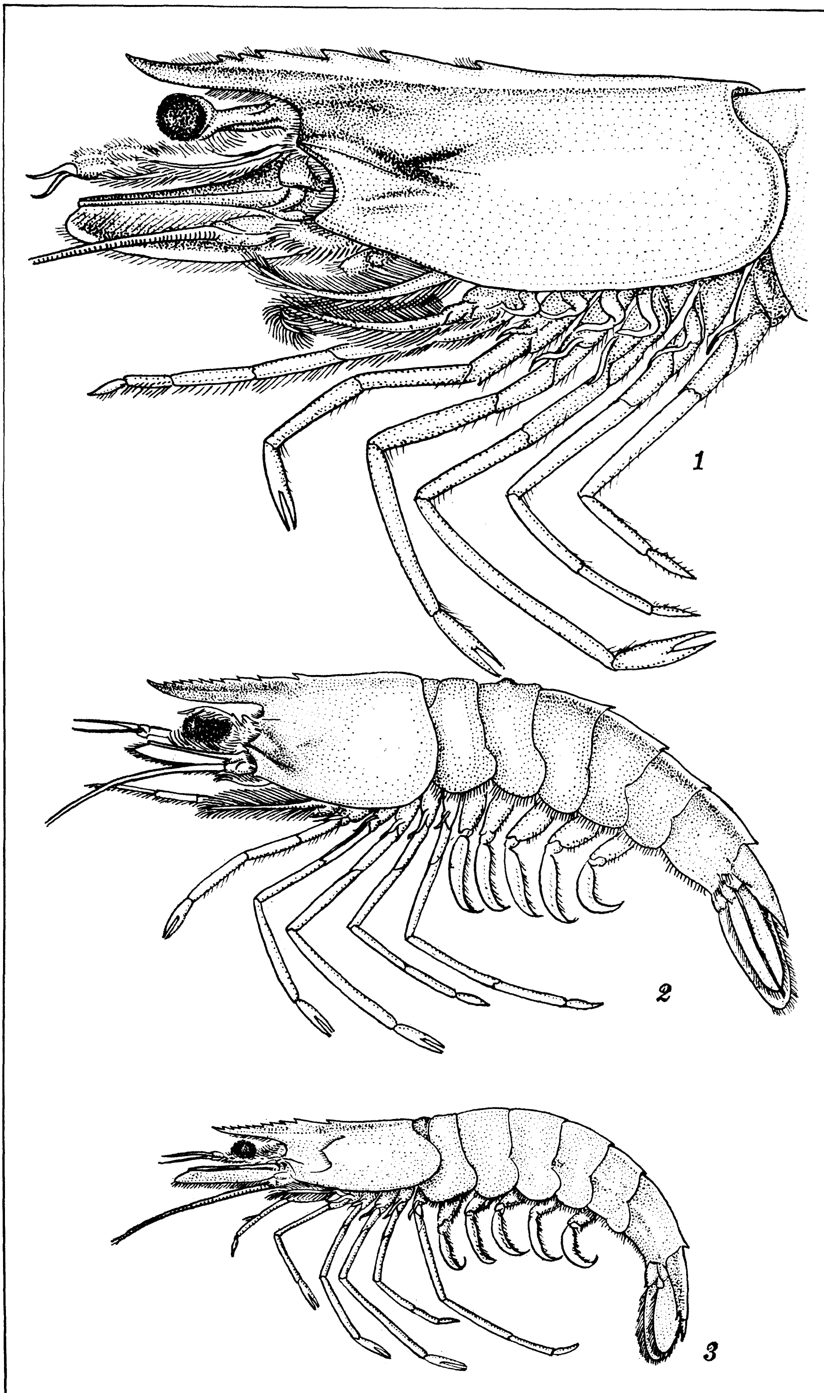

PLATE 3.

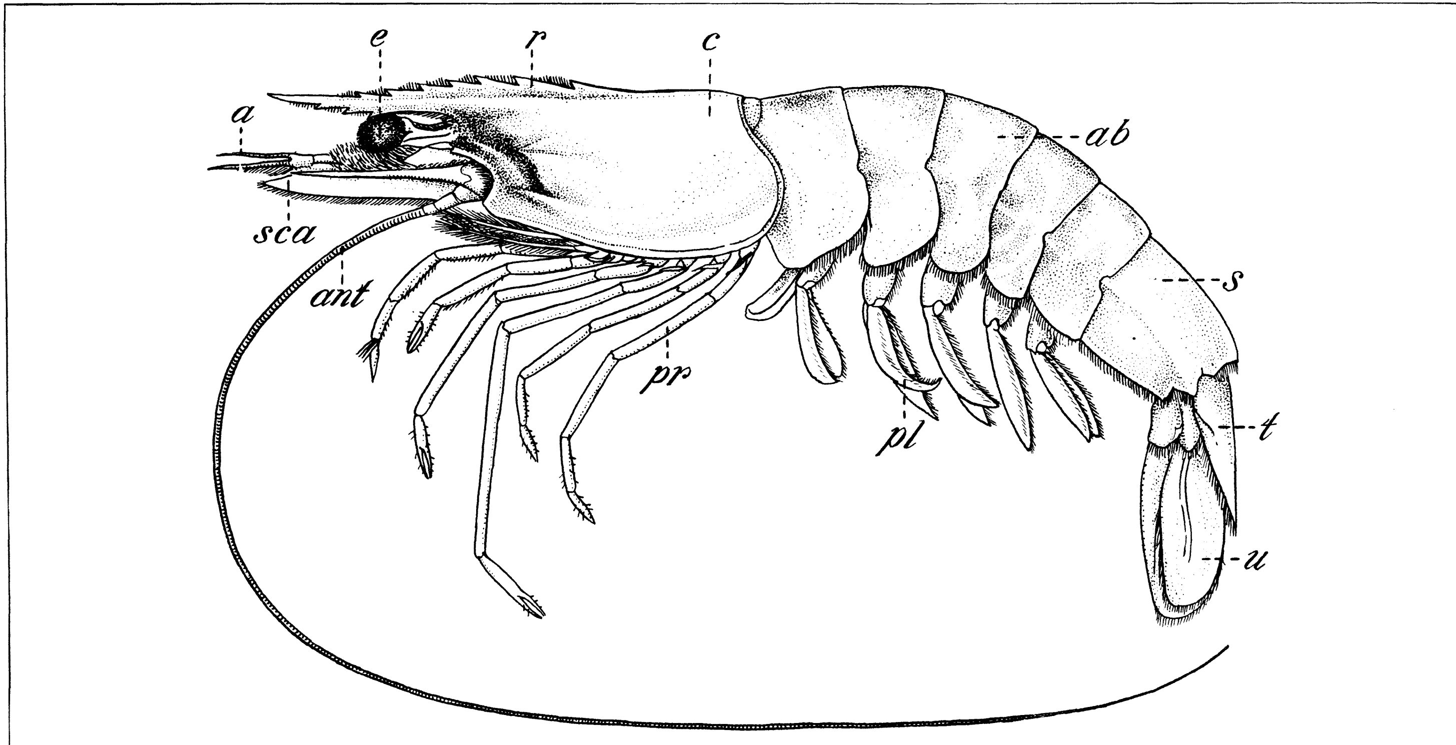

PLATE 4.

DIATOMS FROM ARGUN RIVER, HSING-AN-PEI PROVINCE, MANCHOUKUO

By B. W. SKVORTZOW
Of Harbin, Manchoukuo

TWO PLATES

The material reported in the following pages was collected by Mr. P. A. Pavlov, the enthusiastic collector of the former Manchuria Research Society of Harbin, in the summer of 1927 in the environs of the Chalainor station of the Chinese Eastern Railway, at the source of Argun River, which arises from Dalai-nor or Talaihu Lake. The collection consists of only one tube of specimens. Thanks are due to Mr. P. A. Pavlov for placing the material at my disposal.

Only one of my papers deals with the diatom flora of Dalai-nor Lake.[1] Another paper deals with diatoms from the Great Khingan mountains, east of Argun River.[2] A third deals with the diatom flora of the Hailar district.[3] The diatom flora of Argun River is quite rich, being represented by 163 different forms in the single sample examined. The following species predominate in the Argun collection:

Cyclotella Meneghiniana fo. *plana.*
Synedra ulna.
Caloneis silicula.
Neidium dubium and fo. *argunensis.*
Navicula cuspidata var. *ambigua.*
Navicula pupula var. *capitata* and var. *elliptica.*
Navicula protracta.
Cymbella cuspidata.
Nitzschia acicularis.

Of 163 different diatoms 137 were fresh-water species, and about 25 are also known in slightly brackish water. They are the following:

Caloneis silicula.
Anomoeoneis sphaerophora.
Navicula crucicula var. *obtusata.*
Navicula cryptocephala var. *veneta.*
Navicula rhynchocephala var. *tenua.*
Navicula viridula and three varieties.
Navicula hungarica var. *linearis* and two other varieties.

[1] Philip. Journn. Sci. 41 (1930) 31.
[2] Ibid. 35 (1928) 39.
[3] Hedwigia (1928).

Navicula lanceolata.
Navicula oblonga var. *subparallela.*
Amphora veneta.
Cymbella prostrata.
Epithemia turgida.
Epithemia sorex.
Rhopalodia gibba var. *ventricosa.*
Rhopalodia gibberula.
Nitzschia tryblionella var. *levidensis.*
Nitzschia commutata.
Nitzschia frustulum var. *perminuta.*
Nitzschia acicularis.
Cymatopleura elliptica var. *nobilis.*
Surirella ovata and var. *pinnata.*
Surirella tientsinensis.

The following nine diatoms from Argun river are proposed as new:

Neidium dubium fo. *argunensis.*
Navicula bacillum var. *parallela.*
Navicula argunensis.
Navicula viridula var. *rostrata* and var. *argunensis.*
Navicula hungarica var. *lanceolata.*
Pinnularia tibetica var. *argunensis.*
Pinnularia viridis var. *commutata* fo. *argunensis.*
Cymbella naviculiformis fo. *constricta.*

From a geographical point of view the following diatoms are of interest: *Achnanthes Peragalli* var. *nipponica,* known from Kizaki lake, Nippon; *Frustulia vulgaris* var. *asiatica,* reported from the Great Khingan mountains, Manchoukuo; *Gyrosigma attenuatum* var. *asiatica,* reported from western China; *Caloneis Schroederii,* known from Europe; *Navicula rhynchocephala* var. *tenua,* reported from western China; *Navicula amphibola* var. *manshurica,* known from the Great Khingan mountains; *Cymbella Moelleriana,* known from Europe; *Surirella robusta* fo. *lata,* found by Fr. Hustedt in Nippon; *Surirella tientsinensis,* reported from brackish water near Tientsin, northern China, and from Hanka Lake, of Eastern Siberia.

The similarity of the diatom flora of Argun River to that of Dalai-nor Lake is borne out by a series of common species; namely: *Anomoeoneis sphaerophora, Navicula gastrum, Navicula cuspidata* and var. *ambigua, Nitzschia tryblionella* var. *levidensis, Cymatopleura elliptica, Surirella ovata,* and *Epithemia* spp.

The 163 diatoms found in the sample are described below. Half of them are figured. Both Latin and English diagnoses are given for new forms.

MELOSIRA VARIANS C. A. Agardh.

Melosira varians C. A. Agardh, FR. HUSTEDT, Bacillar. (1930) 85, 86, fig. 41.

Valve height and breadth about 0.012 mm. Rare. A species of cosmopolitan distribution. Reported from North Manchuria, from rapidly running water in Imengol River, near Hailar, and the Great Khingan mountains.

MELOSIRA GRANULATA (Ehr.) Ralfs STATUS X.

Melosira granulata (Ehr.) Ralfs *status X*, FR. HUSTEDT, Bacillar. (1930) 87, 88, fig. 44.

Valve height 0.015 mm; breadth, 0.007. Striæ and granules 8 in 0.01 mm. Infrequent. Reported from plankton of lakes and rivers. Common in Sungari river, near Harbin.

MELOSIRA GRANULATA (Ehr.) Ralfs STATUS B.

Melosira granulata (Ehr.) Ralfs *status B*, FR. HUSTEDT, Bacillar. (1930) 87, 88, fig. 44.

Differs from the preceding form in the coarser striæ and granules. Valve height, 0.012 mm; breadth, 0.01. Striæ 12, granules 10 in 0.01 mm. Common.

MELOSIRA DISTANS (Ehr.) Kütz. var. ALPIGERA Grunow.

Melosira distans (Ehr.) Kütz. var. *alpigera* Grunow, FR. HUSTEDT, Bacillar. (1930) 93, fig. 54.

Valve height 0.0067 mm; breadth, about 0.005. Striæ oblique, 18 in 0.01 mm. Rare. The type was reported from the Great Khingan mountains.

MELOSIRA BINDERANA Kützing.

Melosira Binderana Kützing, FR. HUSTEDT, Bacillar. (1930) 86, 87, fig. 43.

Valve height, 0.0068 mm; breadth, 0.003. Common. Known from plankton of large lakes. Common in Baikal Lake of Siberia.

CYCLOTELLA OPERCULATA (Ag.) Kützing. Plate 1, fig. 10.

Cyclotella operculata (Ag.) Kützing, FR. HUSTEDT, Bacillar. (1930) 102, fig. 66.

Diameter of the valve about 0.01 mm. Striæ 15 in 0.01 mm. Central area indistinctly punctate. Reported from littoral zones of lakes. Common.

CYCLOTELLA MENEGHINIANA Kützing fo. PLANA Fricke.

Cyclotella Meneghiniana Kützing fo. *plana* Fricke, FR. HUSTEDT, Bacillar. (1930) 100, fig. 67.

Diameter of the valve, 0.01 mm. Striæ 9 in 0.01 mm. One isolated puncta in the central area distinct. Reported from

Dalai-nor Lake, and in Transbaikalia from Kenon and Baikal Lakes. Very common.

CYCLOTELLA GLOMERATA Bachm.

Cyclotella glomerata Bachm., FR. HUSTEDT, Bacillar. (1930) 105, 106, fig. 81*c*.

Valve minute, about 0.0085 mm. Striæ 13 to 15 in 0.01 mm. Reported from plankton of subalpine lakes. New to Manchoukuo. Common.

STEPHANODISCUS HANTZSCHII Grunow. Plate 2, fig. 8.

Stephanodiscus Hantzschii Grunow, FR. HUSTEDT, Bacillar. (1930) 110, fig. 87.

A minute diatom with delicate radiating rows of puncta. Diameter of the valve 0.01 mm. Rows of puncta 12 in 0.01 mm. Reported from rivers and lakes. Found in winter plankton of Sungari river near Harbin. Common.

TABELLARIA FENESTRATA (Lyngb.) Kützing.

Tabellaria fenestrata (Lyngb.) Kützing, FR. HUSTEDT, Bacillar. (1930) 122, 123, fig. 99.

Known from littoral and pelagic parts of ponds and lakes. Common in mountain bogs. Reported from the Great Khingan mountains and Hailar. Rare.

DIATOMA ANCEPS (Ehr.) Grunow. Plate 1, fig. 22.

Diatoma anceps (Ehr.) Grunow, FR. HUSTEDT, Bacillar. (1930) 130, fig. 117.

Valve linear, with produced and subcapitate ends. Length, 0. 027 mm; breadth, 0.0032. Costæ 6 in 0.01 mm. Differs from the type in its subrostrate and subacute, not capitate, ends. Rare. Reported from mountain streams and rivers.

MERIDION CIRCULARE Agardh.

Meridion circulare Agardh, FR. HUSTEDT, Bacillar. (1930) 131, 132, fig. 118.

Length, 0.037 mm; breadth, 0.005. Costæ 4 in 0.01 mm. Rare. Known from the Great Khingan mountains, Hailar, and Baikal Lake.

OPEPHORA MARTYI Heribaud.

Opephora Martyi Heribaud, FR. HUSTEDT, Bacillar. (1930) 132, 133, fig. 120.

Valve elongate, with robust costæ. Length, 0.012 mm; breadth, 0.0035. Costæ 9 in 0.01 mm. Rare. Reported from Baikal Lake.

CERATONEIS ARCUS Kützing.

Ceratoneis arcus Kützing, FR. HUSTEDT, Bacillar. (1930) 134, 135, fig. 122.

Valve arcuate, produced at the ends. Length, 0.06 mm; breadth, 0.005. Rare. Reported from Hailar and Baikal Lake.

FRAGILARIA INTERMEDIA Grunow.

Fragilaria intermedia Grunow, FR. HUSTEDT, Bacillar. (1930) 139, fig. 130.

Valve length, 0.02 mm; breadth, 0.0034. Striæ 12 in 0.01 mm. Common. Reported from Kenon and Baikal Lakes.

SYNEDRA ULNA (Nitz.) Ehr.

Synedra ulna (Nitz.) Ehr., FR. HUSTEDT, Bacillar. (1930) 151, fig. 159*a*, *b*.

Very common. Reported from rivers and lakes. Known from Hailar, Great Khingan, and Baikal Lake.

SYNEDRA ULNA (Nitz.) Ehr. var. LANCEOLATA Kützing. Plate 2, fig. 7.

Synedra ulna (Nitz.) Ehr. var. *lanceolata* Kützing, A. SCHMIDT, Atlas Diatom. (1914) pl. 302, figs. 15–17, 19.

Differs from the type in its narrow-attenuate ends. Length, 0.081 mm; breadth, 0.006. Striæ 10 in 0.01 mm. Common. Reported from the Tropics.

SYNEDRA ULNA (Nitz.) Ehr. var. AEQUALIS (Kütz.) Hustedt.

Synedra ulna (Nitz.) Ehr. var. *aequalis* (Kütz.) Hustedt, FR. HUSTEDT, Bacillar. (1930) 152, fig. 164.

Several frustules. Not reported from Manchoukuo.

SYNEDRA ACUS Kütz. var. RADIANS (Kütz.) Hustedt.

Synedra acus Kütz. var. *radians* (Kütz.) Hustedt, FR. HUSTEDT, Bacillar. (1930) 155, fig. 171.

Valve length, 0.119 mm; breadth, 0.0034. Striæ 10 to 11 in 0.01 mm. Reported from littoral parts of lakes and from ponds. Infrequent.

SYNEDRA PARASITICA (W. Smith) var. SUBCONSTRICTA Grunow. Plate 1, fig. 29.

Synedra parasitica (W. Smith) var. *subconstricta* Grunow, FR. HUSTEDT, Bacillar. (1930) 161, fig. 196.

Valve lanceolate, constricted in the middle, with attenuate-capitate ends. Length, 0.019 mm; breadth, 0.0034. Striæ 18 in 0.01 mm. Rare. Reported from fresh water.

SYNEDRA VAUCHERIAE Kützing.

Synedra Vaucheriae Kützing, FR. HUSTEDT, Bacillar. (1930) 161, fig. 192.

Valve linear-lanceolate. Length, 0.02 mm; breadth, 0.0042. Striæ 15 in 0.01 mm. Infrequent. Reported from Kenon and Baikal Lakes, and from the Great Khingan mountains.

EUNOTIA PECTINALIS (Kütz.) Rabh. var. UNDULATA (Ralfs) Rabh.

Eunotia pectinalis (Kütz.) Rabh. var. *undulata* (Ralfs) Rabh., FR. HUSTEDT, Bacillar. (1930) 182, fig. 240.

Valve with undulate dorsal sides. Length, 0.073 mm; breadth, 0.009. Striæ 7 to 8 in 0.01 mm. Rare. Common in bogs and swamps. Reported from Baikal Lake.

EUNOTIA LUNARIS (Ehr.) Grunow.

Eunotia lunaris (Ehr.) Grunow, FR. HUSTEDT, Bacillar. (1930) 183, 184, fig. 249.

Valve length, 0.054 mm; breadth, 0.003. Striæ about 18 in 0.01 mm. Rare. A diatom common in stagnant water. Reported from the Great Khingan mountains and from Baikal Lake.

EUNOTIA PRAERUPTA Ehr. var. INFLATA Grunow.

Eunotia praerupta Ehr. var. *inflata* Grunow, FR. HUSTEDT, Bacillar. (1930) 174, fig. 212.

Valve with arcuate dorsal margin. Length, 0.027 mm; breadth, 0.013. Striæ 8 in 0.01 mm. Rare. Reported from swamps.

EUNOTIA MONODON Ehr. var. MAJOR (W. Smith) Hustedt.

Eunotia monodon Ehr. var. *major* (W. Smith) Hustedt, FR. HUSTEDT, Bacillar. (1930) 186, fig. 255.

Valve arcuate, with capitate ends. Length, 0.127 mm; breadth, 0.01. Rare. Common in mountains in the northern part of Manchoukuo.

COCCONEIS PLACENTULA (Ehr.) var. EUGLYPTA (Ehr.) Cleve.

Cocconeis placentula (Ehr.) var. *euglypta* (Ehr.) Cleve, FR. HUSTEDT, Bacillar. (1930) 190, fig. 261.

Upper valve with distinct longitudinal bands. Length, 0.015 mm; breadth, 0.008. Striæ 18 to 20 in 0.01 mm. Common. Reported from Kenon and Baikal Lakes.

COCCONEIS PLACENTULA (Ehr.) var. LINEATA (Ehr.) Cleve.

Cocconeis placentula (Ehr.) var. *lineata* (Ehr.) Cleve, FR. HUSTEDT, Bacillar. (1930) 190, fig. 262.

Common. Length, 0.027 mm; breadth, 0.02. Reported from Kenon and Baikal Lakes.

ACHNANTHES LANCEOLATA Breb. var. **ROSTRATA** Hustedt. Plate 2, fig. 19.

Achnanthes lanceolata Breb. var. *rostrata* Hustedt, FR. HUSTEDT, Bacillar. (1930) 208, fig. 306*b*.

Fairly common in Argun River. Length, 0.01 mm; breadth, 0.0042. Striæ 15 in 0.01 mm. Reported from Kenon Lake.

ACHNANTHES BIASOLETTIANA Kützing. Plate 2, fig. 14.

Achnanthes Biasolettiana Kützing, FR. HUSTEDT, Bacillar. (1930) 199, fig. 289.

Valve broad, linear-elliptic, with obtuse subrostrate ends. Upper valve with narrow linear axial and central area. Lower valve with radiate striæ, very narrow axial area, and slightly enlarged central area. Length, 0.015 mm; breadth, 0.005. Striæ of the lower valve, 25 in 0.01 mm in the middle, 30 at the ends. Rare. Reported from Europe.

ACHNANTHES PERAGALLI Brun and Herib. var. **NIPPONICA** Skvortzow.

Achnanthes Peragalli Brun and Herib. var. *nipponica* SKVORTZOW, Diatoms from Kizaki Lake, Nippon (1936) pl. 2, fig. 1.

Valve lanceolate, convex, with attenuate, long ends. Length, 0.024 mm; breadth, 0.01. Upper valve with broad axial area. Central area of the lower valve with a broad stauros. Striæ 12 in 0.01 mm. Rare. Known from Kizaki Lake, Nippon.

FRUSTULIA VULGARIS Thwaites var. **ASIATICA** Skvortzow. Plate 1, fig. 39.

Frustulia vulgaris Thwaites var. *asiatica* SKVORTZOW, Diatoms from Khingan, North Manchuria (1928) 42, pl. 2, fig. 12.

Valve narrow-linear, with parallel margin and subrostrate obtuse ends. Length, 0.042 mm; breadth, 0.0068. Transverse striæ about 25 to 28 in 0.01 mm. Infrequent. Reported from the Great Khingan mountains.

GYROSIGMA ATTENUATUM (Kütz.) Rabh. var. **ASIATICA** Skvortzow.

Gyrosigma attenuatum (Kütz.) Rabh. var. *asiatica* SKVORTZOW, Diatoms from Chengtu, Szechwan, Western China (1938) pl. 4, fig. 8.

Valve gently sigmoid, lanceolate, gradually tapering from the middle to the obtuse ends. Length, 0.0278 mm; breadth, 0.03. Longitudinal striæ 8, transverse 12 to 15 in 0.01 mm. Rare. Reported from Western China.

GYROSIGMA ACUMINATUM (Kütz.) Rabh. Plate 1, fig. 7.

Pleurosigma acuminatum (Kütz.) Grun., H. PERAGALLO, Monographie du Genre *Pleurosigma* (1890–1891) 20, pl. 7, fig. 36.

Valve sigmoid with attenuate ends. Length, 0.098 mm; breadth, 0.012. Striæ, longitudinal and transversal, 18 in 0.01

mm. Smaller than the type. Common. Reported from Kenon and Baikal Lakes.

CALONEIS SILICULA (Ehr.) Cleve.

Caloneis silicula (Ehr.) Cleve, VAN HEURCK, Synopsis (1881–1885) pl. 12, fig. 18.

Very common, variable in size. Length, 0.054 to 0.096 mm; breadth, 0.01 to 0.015. Striæ 15 to 18 in 0.01 mm. Very common. Reported from Kenon and Baikal Lakes. A fresh and brackish-water diatom.

CALONEIS BACILLUM (Grun.) Mereschkovski.

Caloneis bacillum (Grun.) Mereschkovski, FR. HUSTEDT, Bacillar. (1930) 236, fig. 360.

Valve linear, with parallel margins and broad ends. Length, 0.0306 mm; breadth, 0.005. Striæ 21 to 24 in 0.01 mm. Common. Reported from fresh and brackish water.

CALONEIS SCHROEDERI Hustedt. Plate 2, fig. 24.

Caloneis Schroederi Hustedt, FR. HUSTEDT, Bacillar. (1930) 235, fig. 356.

Valve linear-elliptic, with cuneate-rounded ends. Middle part constricted. Median line filiform, slightly curved, with distinct terminal comma-shaped fissures. Axial area broad, central area a transverse fascia reaching the margin. Striæ radiate throughout, with distinct longitudinal band. Length, 0.027 mm; breadth, 0.005. Striæ 12 in 0.01 mm. Rare. Known from Europe. New in Manchoukuo.

DIPLONEIS OVALIS (Hilse) Cleve.

Diploneis ovalis (Hilse) Cleve, FR. HUSTEDT, Bacillar. (1930) 249, fig. 390.

Valve elliptic. Length, 0.02 mm; breadth, 0.01. Striæ 21 in 0.01 mm, distinctly punctate. Rare.

DIPLONEIS OVALIS (Hilse) Cleve var. OBLONGELLA (Naeg.) Cleve.

Diploneis ovalis (Hilse) Cleve var. *oblongella* (Naeg.) Cleve, FR. HUSTEDT, Bacillar. (1930) 249, fig. 391.

Differs from the type in its elongate valves. Punctation indistinct. Length, 0.0255 mm; breadth, 0.012. Striæ 11 in 0.01 mm. Rare.

NEIDIUM BISULCATUM (Lagerst.) Cleve.

Neidium bisulcatum (Lagerst.) Cleve, FR. HUSTEDT, Bacillar. (1930) 242, fig. 374.

Valve linear, with rounded ends. Length, 0.034 mm; breadth, 0.007. Striæ about 25 in 0.01 mm. Common. Reported from mountain districts.

NEIDIUM IRIDIS (Ehr.) Cleve.

Neidium iridis (Ehr.) Cleve, FR. HUSTEDT, Bacillar. (1930) 245, fig. 379.

Common and typical. Length, 0.072 mm; breadth, 0.0187. Striæ 18 in 0.01 mm. Reported from Baikal.

NEIDIUM IRIDIS (Ehr.) Cleve var. AMPHIGOMPHUS (Ehr.) Van Heurck.

Neidium iridis (Ehr.) Cleve var. *amphigomphus* (Ehr.) Van Heurck, FR. HUSTEDT, Bacillar. (1930) 245, fig. 382.

Differs from the type in its cuneate ends. Length, 0.057 mm; breadth, 0.015. Striæ 18 to 20 in 0.01 mm. Common. Reported from Kenon Lake.

NEIDIUM AFFINE (Ehr.) Cleve fo. HERCYNICA (A. Mayer) Hustedt. Plate 1, fig. 18.

Neidium affine (Ehr.) Cleve fo. *hercynica* (A. Meyer) Hustedt, FR. HUSTEDT, Bacillar. (1930) 243.

Valve linear-elliptic, with obtuse ends. Length, 0.032 mm; breadth, 0.0076. Striæ 22 to 24 in 0.01 mm. Common. Reported from Europe.

NEIDIUM AFFINE (Ehr.) Cleve var. AMPHIRYNCHUS (Ehr.) Cleve.

Neidium affine (Ehr.) Cleve fo. *hercynica* (A. Mayer) Hustedt, FR. HUSTEDT, Bacillar. (1930) 243, fig. 377.

Valve linear, with rostrate ends. Length, 0.035 to 0.078 mm; breadth, 0.009 to 0.019. Striæ 25 in 0.01 mm. Common. Reported from Hailar, the Great Khingan mountains, and Baikal Lake.

NEIDIUM PRODUCTUM (W. Smith) Cleve.

Neidium productum (W. Smith) Cleve, FR. HUSTEDT, Bacillar. (1930) 245, fig. 383.

Infrequent. Valve ends produced in long subacute ends. Length, 0.045 mm; breadth, 0.014. Striæ 20 in 0.01 mm. Narrower than the type. Not common.

NEIDIUM DUBIUM (Ehr.) Cleve.

Neidium dubium (Ehr.) Cieve, FR. HUSTEDT, Bacillar. (1930) 246, fig. 384*a*.

Valve elliptic, with rostrate ends. Length, 0.034 to 0.056 mm; breadth, 0.012 to 0.018. Striæ 20 to 30 in 0.01 mm. Very common. Reported from Kenon and Baikal Lakes.

NEIDIUM DUBIUM (Ehr.) Cleve fo. ARGUNENSIS fo. nov. Plate 1, figs. 6 and 26.

Differt a typo valvis anguste et polis cuneatis. Longis valvis 0.018 ad 0.024 mm; latis valvis 0.0068 ad 0.0085. Habit. in Argun rivulus, prope Chalainor, Manchoukuo Occidentalis. Legit P. A. Pavlov.

Differs from the type in its cuneate ends and narrower valves. Length, 0.018 to 0.024 mm; breadth, 0.0068 to 0.0085. Striæ 18 to 20 in 0.01 mm. Very common.

STAURONEIS ANCEPS Ehr.

Stauroneis anceps Ehr., FR. HUSTEDT, Bacillar. (1930) 256, fig. 405.

Common. Length, 0.064 mm; breadth, 0.014. Striæ 18 in 0.01 mm. Reported from Hailar, and from Kenon and Baikal Lakes.

STAURONEIS ANCEPS Ehr. fo. GRACILIS (Ehr.) Cleve.

Stauroneis anceps Ehr. fo. *gracilis* (Ehr.) Cleve, FR. HUSTEDT, Bacillar. (1930) 256, fig. 406.

Infrequent. Length, 0.073 mm; breadth, 0.015. Reported from Baikal Lake.

STAURONEIS PHOENICENTERON Ehr. fo. GRACILIS (Dippel).

Stauroneis phoenicenteron Ehr. fo. *gracilis* (Dippel), FR. HUSTEDT, Bacillar. (1930) 255.

Valve lanceolate, tapering from the middle to acute ends. Length, 0.09 to 0.095 mm; breadth, 0.017 to 0.018. Striæ 18 to 21 in 0.01 mm. Common. Reported from Hailar, the Great Khingan mountains, and Baikal Lake.

STAURONEIS ACUTA W. Smith.

Stauroneis acuta W. Smith, FR. HUSTEDT, Bacillar. (1930) 259, fig. 415.

Not unfrequent. Length, 0.088 mm; breadth, 0.017. Striæ 11 in 0.01 mm. Reported from the Great Khingan mountains and from Sungari River.

ANOMOEONEIS SPHAEROPHORA (Kütz.) Pfitzer.

Anomoeoneis sphaerophora (Kütz.) Pfitzer, FR. HUSTEDT, Bacillar. (1930) 262, fig. 422.

Length, 0.072 mm; breadth, 0.02. Infrequent. Reported from fresh and brackish waters. Known from Kenon and Dalai-nor Lakes.

Genus NAVICULA Bory

NAVICULÆ ORTHOSTICHÆ CLEVE

NAVICULA CUSPIDATA Kützing.

Navicula cuspidata Kützing, FR. HUSTEDT, Bacillar. (1930) 268, fig. 433.

Common. Length, 0.085 to 0.102 mm; breadth, 0.012 to 0.29. Striæ 12 to 14 in 0.01 mm. A species of cosmopolitan distribution. Reported from Kenon, Dalai-nor, and Baikal Lakes.

NAVICULA CUSPIDATA Kütz. var. AMBIGUA (Ehr.) Cleve.

Navicula cuspidata Kütz. var. *ambigua* (Ehr.) Cleve, FR. HUSTEDT, Bacillar. (1930) 268, fig. 434.

Differs from the type in its attenuate subrostrate ends. Length, 0.073 to 0.076 mm; breadth, 0.018 to 0.02. Striæ 18 to 24 in 0.01 mm. Very common. Reported from Kenon, Dalai-nor, and Baikal Lakes.

NAVICULÆ BACILLARES CLEVE

NAVICULA AMERICANA Ehr.

Navicula americana Ehr., FR. HUSTEDT, Bacillar. (1930) 280, fig. 464.

Valve linear, with parallel margins and broad-rounded ends. Median line bordered on each side by a siliceous rib. Axial area broad. Striæ radiate. Length, 0.047 mm; breadth, 0.014. Striæ in the middle 12 in 0.01 mm. Rare. New in Manchoukuo.

NAVICULA BACILLUM Ehr. var. PARALLELA var. nov. Plate 1, figs. 34 and 35.

Differt a typo valvis linearis cum marginem parallelis. Longis valvis 0.029 ad 0.047 mm; latis valvis 0.0085. Striis ad medio 15 ad 20, ad polos 24 ad 25 in 0.01 mm. Habit. in Argun rivulis prope Chalainor, Manchoukuo Occidentalis. Legit P. A. Pavlov.

Valve linear or elliptic, with parallel margins and broad-obtuse ends. Median line bordered by a siliceous rib. Terminal nodules with two distinct lateral expansions. Length, 0.029 to 0.047 mm; breadth, 0.0085. Striæ in the middle 15 to 20, at the ends 24 to 25 in 0.01 mm. Differs from the type in its parallel margins. Not to be confused with *Navicula Lambda* Cleve var. *nipponica* Skv. and var. *densistriata* Skv. reported from Nippon. Common.

NAVICULA PUPULA Kütz. var. ROSTRATA Hustedt. Plate 2, fig. 13.

Navicula pupula Kütz. var. *rostrata* Hustedt, FR. HUSTEDT, Bacillar. (1930) 282, fig. 467*e*.

Valve elliptic-lanceolate, with distinct terminal lateral expansions. Length, 0.0187 to 0.025 mm; breadth, 0.007 to 0.0085. Striæ 15 to 20 in 0.01 mm. Median striæ longer and shorter. Common. Reported from Baikal Lake.

NAVICULA PUPULA Kütz. var. CAPITATA Hustedt.

Navicula pupula Kütz. var. *capitata* Hustedt, FR. HUSTEDT, Bacillar. (1930) 281, fig. 467*c*.

Valve linear, with slightly capitate ends. Length, 0.03 mm; breadth, 0.0068. Very common. Reported from Kenon and Baikal Lakes.

NAVICULA PUPULA Kütz. var. ELLIPTICA Hustedt.

Navicula pupula Kütz. var. *elliptica* Hustedt, FR. HUSTEDT, Bacillar. (1930) 282, fig. 467*d*.

Valve elliptic-lanceolate. Length, 0.0136 mm; breadth, 0.0055. Smaller than the type. Very common. Known from Baikal Lake.

NAVICULÆ DECIPIENTES CLEVE

NAVICULA CRUCICULA (W. Smith) Donk. var. OBTUSATA Grunow. Plate 2, fig. 2.

Navicula crucicula (W. Smith) Donk. var. *obtusata* Grunow, CLEVE and GRUNOW, Arctische Diatomeen (1880) 35, pl. 2, fig. 37.

Valve elliptic-lanceolate, with obtuse ends. Axial area very narrow, central slightly enlarged. Striæ radiate throughout, more distinct in the middle. Length, 0.032 to 0.04 mm; breadth, 0.01 to 0.012. Striæ, middle 15, at the ends 18 in 0.01 mm. Common. *Navicula crucicula* and its varieties are known from brackish water.

NAVICULA PROTRACTA Grunow. Plate 2, fig. 10.

Navicula protracta Grunow, FR. HUSTEDT, Bacillar. (1930) 284, fig. 472.

Valve lanceolate, with rostrate ends. Length, 0.02 to 0.04 mm; breadth, 0.0068 to 0.012. Striæ, middle 12 to 15, at the ends 18 to 20 in 0.01 mm. Very common. A brackish-water species.

NAVICULA ARGUNENSIS sp. nov. Plate 1, fig. 9.

Valvis elliptico-lanceolatis ad medium modice inflatis cum polis productis et subrostratis. Raphe directa filiformis, area axillaris et centralis angusta linearis. Striis radiantibus delica-

tissimis, 35 in 0.01 mm. Longis valvis 0.0187 mm; latis valvis 0.006. Egrege *Navicula protracta* Grun. Habit. in Argun rivulis prope Chalainor, Manchoukuo Occidentalis. Legit P. A. Pavlov.

Valve elliptic-lanceolate, with subrostrate obtuse ends. Median line filiform, straight. Axial and central areas very narrow. Striæ radiate throughout, very fine, about 35 in 0.01 mm. Length, 0.0187 mm; breadth, 0.006. Rare. Species akin to Sect. *Naviculae decipientes* Cleve.

NAVICULÆ MENISCULÆ CLEVE

NAVICULA ATOMUS (Naeg.) Grunow. Plate 2, fig. 25.

Navicula atomus (Naeg.) Grunow, FR. HUSTEDT, Bacillar. (1930) 288, fig. 484.

Valve minute elliptic, with short and broad ends. Length, 0.009 mm; breadth, 0.0028. Rare.

NAVICULÆ LINEOLATÆ CLEVE

NAVICULA CRYPTOCEPHALA Kützing.

Navicula cryptocephala Kützing, FR. HUSTEDT, Bacillar. (1930) 295, fig. 496.

Valve lanceolate, with attenuate ends. Length, 0.02 mm; breadth, 0.0042. Striæ 14 to 15 in 0.01 mm. Infrequent. Reported from fresh and brackish waters.

NAVICULA CRYPTOCEPHALA Kütz. var. VENETA (Kütz.) Grunow.

Navicula cryptocephala Kütz. var. *veneta* (Kütz.) Grunow, FR. HUSTEDT, Bacillar. (1930) 295, fig. 497*a*.

Smaller and shorter. Length, 0.017 mm; breadth, 0.005. Striæ 15 in 0.01 mm. Infrequent. Reported from Kenon Lake.

NAVICULA RHYNCHOCEPHALA Kütz. var. TENUA Skvortzow. Plate 1, fig. 42.

Navicula rhynchocephala Kütz. var. *tenua* SKVORTZOW, Diatoms from Chengtu, Szechwan, Western China (1938) pl. 4, fig. 13; pl. 3, fig. 24.

Valve lanceolate, gradually tapering to the subcapitate ends. Length, 0.0357 mm; breadth, 0.0077. Striæ radiate, convergent at the ends, 13 in 0.01 mm. Axial area narrow, central suborbicular. Common. Reported from Chengtu, western China.

NAVICULA VIRIDULA Kützing. Plate 1, fig. 16; Plate 2, fig. 30.

Navicula viridula Kützing, CLEVE and GRUNOW, Arctische Diatomeen (1880) 33, pl. 2, fig. 35.

Valve linear-lanceolate, with subrostrate ends. Median line filiform, with distinct comma-shaped terminal fissures. Median

line enclosed in a narrow siliceous rib. Axial area indistinct and very narrow, central area large suborbicular. Striæ radiate, distinctly lineolate, convergent at the ends. Length, 0.051 to 0.066 mm; breadth, 0.009 to 0.0136. Common. Reported from fresh and brackish waters. Known from Baikal Lake.

NAVICULA VIRIDULA Kütz. var. SLESVICENSIS (Grun.) Cleve.

Navicula viridula Kütz. var. *slesvicensis* (Grun.) Cleve, VAN HEURCK, Synopsis (1881–1885) pl. 7, fig. 26.

Valve lanceolate, with obtuse ends. Length, 0.045 mm; breadth, 0.012. Striæ lineolate-radiate, about 8 in 0.01 mm. Infrequent.

NAVICULA VIRIDULA Kütz. var. ROSTRATA var. nov. Plate 1, fig. 17.

Differ a typo valvis polis rostratis. Longis valvis 0.034 mm; latis valvis 0.0085. Striis 10 in 0.01 mm. Habit. in Argun rivulis prope Chalainor, Manchoukuo Occidentalis. Legit P. A. Pavlov.

Valve linear-lanceolate, with parallel margins and rostrate ends. Median line enclosed in a siliceous rib. Axial area very narrow, central broad, suborbicular. Striæ radiate-lineate, convergent at the ends. Length, 0.034 mm; breadth, 0.0085. Striæ 10 in 0.01 mm. A form akin to *Navicula rostellata* Kütz. Differs from *Cymbella hybrida* Grun. in its median line being enclosed in a narrow siliceous rib. Common.

NAVICULA VIRIDULA Kütz. var. ARGUNENSIS Skvortzow. Plate 1, figs. 13 and 33.

Navicula viridula Kütz. var. *argunensis* SKVORTZOW, Diatoms from Kenon Lake, Transbaikalia, Siberia, pl. 1, figs. 9, 33.

Valve narrow-lanceolate, gradually tapering from the middle to the subacute ends. Length, 0.031 to 0.034 mm; breadth, 0.006. Striæ 12 to 13 in 0.01 mm. Common. Reported from Kennon Lake, Transbaikalia, Siberia.

NAVICULA HUNGARICA Grun. var. LINEARIS Oestrup. Plate 2, fig. 18.

Navicula hungarica Grun. var. *linearis* Oestrup, FR. HUSTEDT, Bacillar. (1930) 298, fig. 507.

Valve linear, with obtuse ends. Median line straight with indistinct two lateral expansions from both sides of terminal nodules. Axial area linear, central area a short transverse fascia. Striæ slightly radiate, very robust, 8 in 0.01 mm. Length, 0.017 mm; breadth, 0.005. Rare. Reported from slightly brackish water.

NAVICULA HUNGARICA Grun. var. **CAPITATA** (Ehr.) Cleve. Plate 2, fig. 17.

Navicula hungarica Grun. var. *capitata* (Ehr.) Cleve, FR. HUSTEDT, Bacillar. (1930) 298, fig. 508.

Valve elliptic-lanceolate, with produced subcapitate ends. Length, 0.0187 mm; breadth, 0.006. Striæ 6 in 0.01 mm. Common. Reported from Baikal Lake.

NAVICULA HUNGARICA Grun. var. **LANCEOLATA** var. nov. Plate 1, fig. 40.

Differt a typo valvis lanceolatis cum polis obtusis. Longis valvis 0.02 mm; latis valvis 0.0051. Striis 9 in 0.01 mm. Habit. in Argun rivulis prope Chalainor, Manchoukuo Occidentalis. Legit P. A. Pavlov.

Valve narrow-lanceolate, with obtuse ends. Lateral expansions on both sides of terminal nodules distinct. Axial area narrow, central a transverse fascia curved outwards. Striæ robust, distinctly radiate, 9 in 0.01 mm. Length, 0.02 mm; breadth, 0.0051. Differs from the type in its lanceolate valves. Common.

NAVICULA CINCTA (Ehr.) Kützing.

Navicula cincta (Ehr.) Kützing, FR. HUSTEDT, Bacillar. (1930) 298, fig. 510.

Valve linear-lanceolate, with striæ in the middle longer and shorter, 12 in 0.01 mm. Length, 0.0187 mm; breadth, 0.0042. Common. Reported from Lake Kenon.

NAVICULA CINCTA (Ehr.) Kütz. var. **LEPTOCEPHALA** (Breb.) Grunow.

Navicula cincta (Ehr.) Kütz. var. *leptocephala* (Breb.) Grunow, VAN HEURCK, Synopsis (1881–1885) 82, pl. 7, fig. 16.

Valve with slightly subrostrate ends. Length, 0.029 mm; breadth, 0.005. Striæ 12 in 0.01 mm. Common. Reported from the Great Khingan mountains and Baikal Lake.

NAVICULA RADIOSA Kützing.

Navicula radiosa Kützing, FR. HUSTEDT, Bacillar. (1930) 299, fig. 513.

Valve narrow-lanceolate, tapering from the middle to the acute ends. Length, 0.07 mm; breadth, 0.011. Striæ 12 in 0.01 mm. Common. Reported from Kenon and Baikal Lakes.

NAVICULA REINHARDTII Grunow. Plate 1, fig. 23.

Navicula Reinhardtii Grunow, FR. HUSTEDT, Bacillar. (1930) 301, fig. 519.

Valve elliptic, robust, with thick siliceous membrane. Striæ very robust, striolate, 6 to 8 in 0.01 mm. Length, 0.035 to

0.074 mm; breadth, 0.0136 to 0.017. Common. Reported from Hailar, Great Khingan, and Kenon and Baikal Lakes.

NAVICULA FALAISIENSIS Grun. var. LANCEOLA Grunow? Plate 1, fig. 38.

Navicula falaisiensis Grun. var. *lanceola* Grunow?, FR. HUSTEDT, Bacillar. (1930) fig. 525.

Valve narrow-lanceolate, with attenuate ends. Central area very narrow. Striæ radiate, 18 to 20 in 0.01 mm. Length, 0.024 mm; breadth, 0.0042. Infrequent.

NAVICULA ANGLICA Ralfs.

Navicula anglica Ralfs, FR. HUSTEDT, Bacillar. (1930) 303, figs. 530, 531.

Valve elliptic, with rostrate ends. Length, 0.019 mm; breadth, 0.0076. Striæ 10 to 11 in 0.01 mm. Very common. Reported from Kenon and Baikal Lakes.

NAVICULA PLACENTULA (Ehr.) Grun. fo. ROSTRATA A. Mayer.

Navicula placentula (Ehr.) Grun., fo. *rostrata* A. Mayer, FR. HUSTEDT, Bacillar. (1930) 304, fig. 533.

Valve elliptic, with rostrate ends. Striæ robust, radiate throughout, 8 in 0.01 mm. Length, 0.047 mm; breadth, 0.015. Common. Known from Kenon Lake.

NAVICULA PLACENTULA (Ehr.) Grun. fo. LATIUSCULA (Grun.) Meister. Plate 1, fig. 14.

Navicula placentula (Ehr.) Grun. fo. *latiuscula* (Grun.) Meister, FR. HUSTEDT, Bacillar. (1930) 304, fig. 534.

Valve broad-lanceolate, with short subacute ends. Length, 0.0238 mm; breadth, 0.0115. Striæ 8½ in 0.01 mm. Common. Smaller than the type.

NAVICULA GASTRUM (Ehr.) Donk. Plate 1, fig. 11; Plata 2, fig. 23.

Navicula gastrum (Ehr.) Donk., A. SCHMIDT, Atlas Diatom. (1911) pl. 272, figs. 10, 11.

Valve elliptic, short, with rostrate ends. Striæ longer and shorter in the middle, about 8 to 10 in 0.01 mm. Length, 0.027 to 0.029 mm; breadth, 0.01. Common. Reported from Dalainor, Kenon, and Baikal Lakes.

NAVICULA LANCEOLATA (Agardh) Kützing. Plate 1, fig. 41.

Navicula lanceolata (Agardh) Kützing, FR. HUSTEDT, Bacillar. (1930) 305, fig. 540.

Valve lanceolate, tapering from the middle to the acute ends. Striæ radiate-striolate, 9 to 11 in the middle, 12 to 15 in 0.01

mm at the ends. Length, 0.035 to 0.042 mm; breadth, 0.007 to 0.0085. Common. Reported from fresh and brackish waters.

NAVICULA OBLONGA Kütz. var. SUBPARALLELA Rattray.

Navicula oblonga Kütz. var. *subparallela* RATTRAY, Diatomaceous deposit from North Tolsta, Lewis (1887) 423, pl. 29, fig. 2; OESTRUP, Beiträge zur Kenntniss der Diatomeenflora des Kossogolbeckens in der nordwestlichen Mongolei (1909) pl. 1, fig. 6.

Valve linear, with almost parallel margins and obtuse ends. Length, 0.127 to 0.144 mm; breadth, 0.017 to 0.018. Striæ 6 to 7 in 0.01 mm. Infrequent. Reported from Kenon Lake. The type is known from fresh and brackish water.

NAVICULÆ PUNCTATÆ CLEVE

NAVICULA AMPHIBOLA Cleve var. MANCHURICA Skvortzow.

Navicula amphibola Cleve var. *manschurica* SKVORTZOW, Diatoms from Khingan, North Manchuria (1928) 43, pl. 2, fig. 19.

Differs from the type in its more elongate ends and coarser striæ. Length, 0.047 mm; breadth, 0.017. Striæ 12 in 0.01 mm. Infrequent. Known from the Great Khingan mountains. *Navicula amphibola* is very common in Kenon Lake.

PINNULARIA INTERRUPTA W. Smith.

Pinnularia interrupta W. Smith, FR. HUSTEDT, Bacillar. (1930) 317, fig. 573*b*.

Valve linear, with parallel margins and larger capitate ends. Length, 0.057 mm; breadth, 0.01. Costæ 12 to 13 in 0.01 mm. Common. Known from Baikal Lake.

PINNULARIA TIBETANA Hust. var. ARGUNENSIS var. nov. Plate 2, fig. 34.

Valvis formae typicae consimilis. Differt area centralis uni-duo-interruptis. Longis valvis 0.064 mm; latis valvis 0.015. Costis 11 in 0.01 mm. Habit. in Argun rivulis prope Chalai-nor, Manchoukuo Occidentalis. Legit P. A. Pavlov.

Valve linear, with parallel margins and obtuse ends. Median line filiform with distinct comma-shaped terminal fissures. Axial area dilated, central area a broad fascia, on one side reaching the margin. Length, 0.064 mm; breadth, 0.015. Costæ 11 in 0.01 mm. Differs from the type in its central area interrupted. It must not be confused with var. *stauroneiformis* Skv., reported from Soochow, China. Rare.

PINNULARIA MESOLEPTA (Ehr.) W. Smith.

Pinnularia mesolepta (Ehr.) W. Smith, FR. HUSTEDT, Bacillar. (1930) 319, fig. 575*a*.

Very rare. Length, 0.05 to 0.054 mm; breadth, 0.008 to 0.01. Costæ 10 to 12 in 0.01 mm. Reported from Baikal Lake.

PINNULARIA MICROSTAURON Ehr. Plate 2, figs. 11, 12, and 16.

Pinnularia microstauron Ehr., A. SCHMIDT, Atlas Diatom. (1876) pl. 44, fig. 14; pl. 45, figs. 31–34.

Valve linear, with parallel margins and subrostrate ends. Costæ divergent and convergent at the ends, 12 in 0.01 mm. Length, 0.037 to 0.054 mm; breadth, 0.008 to 0.012. Common. Reported from Dalai-nor Lake.

PINNULARIA MICROSTAURON (Ehr.) Cleve var. BREBISSONII (Kütz.) Hust. fo. LINEARIS O. Müll. Plate 1, fig. 36.

Pinnularia microstauron (Ehr.) Cleve var. *Brebissonii* (Kütz.) Hust. fo. *linearis* O. Müll., FR. HUSTEDT, Bacillar. (1930) 322.

Valve linear-lanceolate, slightly attenuate towards the obtuse ends. Length, 0.04 mm; breadth, 0.01. Striæ 12 in 0.01 mm. Common.

PINNULARIA BOREALIS Ehr.

Pinnularia borealis Ehr., FR. HUSTEDT, Bacillar. (1930) 326, fig. 597.

Infrequent. Length, 0.034 mm; breadth, 0.008. Costæ 5 in 0.01 mm. Reported from Baikal Lake.

PINNULARIA MAJOR (Kütz.) Cleve forma.

Pinnularia major (Kütz.) Cleve, FR. HUSTEDT, Bacillar. (1930) 331, fig. 614.

Agrees closely with the type but smaller. Length, 0.119 mm; breadth, 0.017. Costæ 7 in 0.01 mm. Rare.

PINNULARIA VIRIDIS (Nitz.) Ehr.

Pinnularia viridis (Nitz.) Ehr., FR. HUSTEDT, Bacillar. (1930) 334, fig. 617*a*.

Common. Length, 0.074 mm; breadth, 0.015. Costæ 7 in 0.01 mm. Common. Reported from the Great Khingan, and Kenon and Baikal Lakes.

PINNULARIA VIRIDIS (Nitz.) Ehr. var. COMMUTATA Grun. fo. ARGUNENSIS fo. nov. Plate 2, fig. 15.

Valvis linearibus, prae forma typica angustibus, costis robustis, levissimo divergentibus et convergentibus. Longis valvis 0.062 mm; latis valvis 0.0085. Costis 9 in 0.01 mm. Habit. in Argun rivulis prope Chalai-nor, Manchoukuo. Legit P. A. Pavlov.

Valve linear, with parallel margins and very slightly attenuate, broad-rounded ends. Median line indistinctly complex, broad filiform. Longitudinal band indistinct. Central area broad.

Length, 0.062 mm; breadth, 0.0085. Costæ 9 in 0.01 mm. Differs from the type in its narrower valves, more robust striæ, and in not being as strongly divergent and convergent. Infrequent.

PINNULARIA NOBILIS Ehr. var. FOSSILIS Pantocsek.

Pinnularia nobilis Ehr. var. *fossilis* Pantocsek, CLEVE, Synopsis of naviculoid Diatoms (1894–1895) 2, 93; SKVORTZOW, Neogene diatoms from Wamura, Shinano Prefecture, Central Nippon, pl. 1, fig. 2.

Smaller than the type. Length, 0.165 mm; breadth, 0.02. Costæ 5 to 6 in 0.01 mm. Rare. Reported as a fossil from Europe and Nippon.

PINNULARIA ISOSTAURON (Ehr.) Grunow. Plate 2, fig. 29.

Pinnularia isostauron (Ehr.) Grunow, CLEVE, Synopsis of Naviculoid Diatoms (1894–1895) 2, 93.

Navicula viridis var. *isostauron* Grunow, CLEVE and GRUNOW, Arctische Diatomeen (1880) pl. 1, fig. 14.

Valve linear, with obtuse ends. Median line slightly flexuose, indistinct, complex. Length, 0.025 mm; breadth, 0.005. Costæ 13 in 0.01 mm. Smaller than the type. Infrequent.

PINNULARIA STREPTORAPHE Cleve var. MINOR Cleve.

Pinnularia viridis var. *minor* CLEVE, Diatoms of Finland (1891) 22, pl. 1, fig. 2.

Valve linear, with parallel margin and broad ends. Axial and central area narrow-lanceolate. Striæ moderately divergent in the middle and convergent at the ends, 6 in 0.01 mm. Length, 0.085 to 0.093 mm; breadth, 0.0136 to 0.015. Somewhat narrower than the type. Rare.

AMPHORA OVALIS Kützing.

Amphora ovalis Kützing, FR. HUSTEDT, Bacillar. (1930) 342, fig. 628.

Common. Frustule length, 0.06 to 0.061 mm; breadth, 0.013 to 0.034. Striæ 12 in 0.01 mm. Reported from Dalai-nor and Baikal Lakes.

AMPHORA OVALIS Kütz. fo. GRACILIS (Ehr.) Cleve.

Amphora gracilis Ehr., A. SCHMIDT, Atlas Diatom. (1875) pl. 26, fig. 101.

Frustule narrow elliptic, with rostrate ends. Length, 0.034 mm; breadth, 0.012. Common. Reported from Kenon Lake.

AMPHORA OVALIS Kütz. var. LIBYCA (Ehr.) Cleve.

Amphora libyca Ehr., A. SCHMIDT, Atlas Diatom. (1875) pl. 26, fig. 105.

Differs from the type in its central area distinct on the dorsal side, uniting with a blank band across the striæ. Length, 0.032 mm; breadth, 0.02. Striæ 12 in 0.01 mm. Common. Reported from the Great Khingan mountains.

AMPHORA VENETA Kützing.

Amphora veneta (Kützing), FR. HUSTEDT, Bacillar. (1930) 345, fig. 631.

Valve arcuate, semielliptic, with structureless ventral margin. Median striæ distinctly punctate, 15 to 16; end striæ 20 to 25 in 0.01 mm. Length, 0.02 mm; breadth, 0.08. Infrequent. Known from fresh and brackish water. Reported from Baikal Lake.

CYMBELLA VENTRICOSA Kützing.

Cymbella ventricosa Kützing, FR. HUSTEDT, Bacillar. (1930) 359, fig. 661.

Infrequent. Length, 0.017 to 0.037 mm; breadth, 0.005 to 0.01. Reported from environs of Hailar, from the Great Khingan mountains, and Kenon and Baikal Lakes.

CYMBELLA TURGIDULA Grunow. Plate 1, fig. 37.

Cymbella turgidula Grunow, FR. HUSTEDT, Bacillar. (1930) 362, fig. 670.

Valve asymmetric, with one side more undulate than the other. Ends subrostrate. Length, 0.024 mm; breadth, 0.0085. Striæ, ventral 12, dorsal 9 in 0.01 mm. Infrequent. Common in tropical countries.

CYMBELLA NAVICULIFORMIS Auerswald. Plate 2, fig. 3.

Cymbella anglica LAGERSTEDT, Sotvatt. Diatomaceer fram Spitsbergen (1873) 42, pl. 2, fig. 18.

Valve naviculiform, asymmetric, with rostrate ends. Length, 0.037 mm; breadth, 0.01. Striæ, ventral 12, dorsal 9 in 0.01 mm. Common. Reported from Baikal Lake.

CYMBELLA NAVICULIFORMIS Auerswald fo. CONSTRICTA fo. nov. Plate 2, fig. 4.

Valvis asymmetricis, naviculiformis, prae formae typica leviter arcuatis unilateraliter constrictis. Longis valvis 0.03 mm; latis valvis 0.0085. Striis ventralis 12, dorsalis 9 in 0.01 mm. Habit. in Argun rivulis prope Chalai-nor, Manchoukuo Occidentalis. Legit P. A. Pavlov.

Differs from the type in one of its sides being constricted. Length, 0.03 mm; breadth, 0.0085. Striæ ventral 12, dorsal 9 in 0.01 mm. Infrequent.

CYMBELLA CISTULA (Hemp.) Grunow.

Cymbella cistula (Hemp.) Grunow, FR. HUSTEDT, Bacillar. (1930) 363, fig. 676*a*.

Infrequent. Length, 0.062 mm; breadth, 0.017. Striæ 7 in 0.01 mm. At the ventral side of the central nodule are 3 small puncta, ending the median striæ. Infrequent. Reported from the environs of Hailar, from the Great Khingan mountains, and from Kenon, Dalai-nor, and Baikal Lakes.

CYMBELLA EHRENBERGII Kützing.

Cymbella Ehrenbergii Kützing, FR. HUSTEDT, Bacillar. (1930) 356, fig. 656.

Common. Length, 0.08 mm; breadth, 0.025. Striæ 8 to 10 in 0.01 mm. Known from Kenon Lake.

CYMBELLA TURGIDA (Greg.) Cleve. Plate 2, fig. 28.

Cymbella turgida (Greg.) Cleve, FR. HUSTEDT, Bacillar. (1930) 358, fig. 660.

Valve robust, semielliptic, arcuate, with almost straight ventral margin. Length, 0.024 mm; breadth, 0.01. Striæ, ventral 8, dorsal 6 in 0.01 mm. Infrequent. Reported from the Great Khingan mountains and Baikal Lake.

CYMBELLA MOELLERIANA Grunow. Plate 2, fig. 26.

Cymbella Moelleriana Grunow, A. SCHMIDT, Atlas Diatom. (1875) pl. 9, figs. 71–75.

Valve lanceolate, naviculiform, tapering from the middle to subacute ends. Median line robust, broad, with terminal fissures, curved to one side. Striæ radiate throughout and lineate. Central area slightly asymmetric, eccentric. Length, 0.051 mm; breadth, 0.014. Striæ 11 in 0.01 mm. The specimens from Argun river are broader than the type. A form with more robust striæ, var. *nipponica* Skv., was recently described from the neogene deposits of Nippon in Wamura, Shinano Province. The type is known from Europe. Infrequent.

CYMBELLA ASPERA (Ehr.) Cleve.

Cymbella aspera (Ehr.) Cleve, FR. HUSTEDT, Bacillar. (1930) 365, fig. 680.

Common. Length, 0.168 mm; breadth, 0.034. Striæ dorsal and ventral 7 in 0.01 mm. Reported from the Great Khingan mountains and Baikal Lake.

CYMBELLA PROSTATA (Berkeley) Cleve.

Cymbella prostrata (Berkeley) Cleve, FR. HUSTEDT, Bacillar. (1930) 357, fig. 659.

Valve robust, arcuate, ventral side centrally gibbous, dorsal arcuate, ends obtuse. Striæ very robust, lineate, about 8 in 0.01 mm. Length, 0.03 to 0.056 mm; breadth, 0.012 to 0.0136. Not common. Reported from fresh and brackish water. Known from Kenon and Baikal Lakes.

CYMBELLA HETEROPLEURA Ehr. var. MINOR Cleve.

Cymbella heteropleura Ehr. var. *minor* Cleve, SKVORTZOW, Diatomees recoltees par le Pere E. Licent au Koukounor (1935) 13, pl. 3, fig. 5.

Valve elliptic-lanceolate, with short, obtuse, ends. Length, 0.062 mm; breadth, 0.015. Striæ 10 to 12 in 0.01 mm. Our specimens differs from the var. *minor* Cleve of A. Schmidt [4] by its gradually elongate ends, and in not being rostrate as in the above figures.

CYMBELLA CUSPIDATA Kützing. Plate 2, fig. 5.

Cymbella cuspidata Kützing, A. SCHMIDT, Atlas Diatom. (1875) pl. 9, fig. 50.

Valve elliptic, with rostrate ends. Length, 0.052 to 0.083 mm; breadth, 0.017 to 0.025. Striæ 8 in 0.01 mm. Very common. Reported from the Great Khingan mountains and Baikal Lake.

CYMBELLA AEQUALIS W. Smith. Plate 2, fig. 31.

Cymbella obtusa Greg., A. SCHMIDT, Atlas Diatom. (1875) pl. 9, figs. 41–45.

Valve lanceolate, naviculiform, asymmetric, with produced, obtuse, ends. Length, 0.04 mm; breadth, 0.01. Striæ, ventral and dorsal 8 in 0.01 mm. Differs from the type in its more robust striæ. Infrequent. Common in mountainous districts.

CYMBELLA CYMBIFORMIS (Agardh? Kütz.) Van Heurck.

Cymbella cymbiformis (Agardh? Kütz.) Van Heurck, FR. HUSTEDT, Bacillar. (1930) 362, fig. 672.

Not common. Length, 0.059 mm; breadth, 0.014. Striæ 7 in 0.01 mm.

CYMBELLA TUMIDA (Breb.) Van Heurck.

Cymbella tumida (Breb.) Van Heurck, FR. HUSTEDT, Bacillar. (1930) 366, fig. 677.

Valve arcuate, with slightly undulate margins. A distinct stigma with a fissure below the central nodule. Length, 0.068

[4] Atlas Diatom. (1875) pl. 9, figs. 51 and 52.

mm; breadth, 0.018. Not common. Reported from Baikal Lake.

GOMPHONEMA ANGUSTATUM (Kütz.) Rabh. var. PRODUCTA Grun. Plate 1, fig. 27.

Gomphonema angustatum (Kütz.) Rabh. var. *producta* Grun., FR. HUSTEDT, Bacillar. (1930) 373, fig. 693.

Valve clavate, apex and basis obtuse-capitate. Length, 0.039 mm; breadth, 0.01. Striæ 7 in 0.01 mm. Common.

GOMPHONEMA PARVULUM (Kütz.) Grun. var. SUBELLIPTICA Cleve.

Gomphonema parvulum (Kütz.) Grun. var. *subelliptica* Cleve, FR. HUSTEDT, Bacillar. (1930) 373, fig. 713*b*.

Infrequent. Length, 0.012 mm; breadth, 0.0034. Striæ 12 to 13 in 0.01 mm.

GOMPHONEMA CONSTRICTUM Ehr.

Gomphonema constrictum Ehr., FR. HUSTEDT, Bacillar. (1930) 377, fig. 714.

Valve with broad, capitate, apex. Length, 0.032 mm; breadth, 0.01. Rare. Reported from the environs of Hailar, from Kenon and Baikal Lakes.

GOMPHONEMA CONSTRICTUM Ehr. var. CAPITATA (Ehr.) Cleve.

Gomphonema constrictum Ehr. var. *capitata* (Ehr.) Cleve, FR. HUSTEDT, Bacillar. (1930) 377, fig. 715.

Valve with very enlarged upper part and obtuse apex. Basis attenuate and subacute. Length, 0.034 mm; breadth, 0.0085. Infrequent. Reported from Kenon and Baikal Lakes.

GOMPHONEMA AUGUR Ehr. var. GAUTIERI Van Heurck.

Gomphonema augur Ehr. var. *Gautieri* Van Heurck, FR. HUSTEDT, Bacillar. (1930) 372, fig. 689.

Valve clavate, with broad, subcapitate, apiculate, apex. Basis narrow-attenuate. Length, 0.051 mm; breadth, 0.012. Striæ 8 in 0.01 mm. Not common. Reported from Baikal Lake.

GOMPHONEMA ACUMINATUM Ehr. var. BREBISSONII (Kütz.) Cleve.

Gomphonema acuminatum Ehr. var. *Brebissonii* (Kütz.) Cleve, FR. HUSTEDT, Bacillar. (1930) 370, fig. 685.

Longer than the type. Length, 0.076 mm; breadth, 0.012. Infrequent. Reported from the Great Khingan mountains.

GOMPHONEMA LANCEOLATUM Ehr. forma. Plate 2, fig. 21.

Valve clavate, minute, with broad-obtuse apex and produced subacute ends. Length, 0.017 mm; breadth, 0.005. Striæ 10 in 0.01 mm. Rare.

EPITHEMIA ZEBRA (Ehr.) Kützing. Plate 2, fig. 20.

Epithemia zebra (Ehr.) Kützing, FR. HUSTEDT, Bacillar. (1930) 384, fig. 729.

Valve variable in size. Length, 0.017 to 0.45 mm; breadth, 0.0086 to 0.013. Costæ 3, striæ 12 in 0.01 mm. Common. Reported from the environs of Hailar and Dalai-nor and Baikal Lakes.

EPITHEMIA ZEBRA (Ehr.) Kütz. var. PORCELLUS (Kütz.) Grunow. Plate 1, fig. 24; Plate 2, fig. 22.

Epithemia zebra (Ehr.) Kütz. var. *porcellus* (Kütz.) Grunow, A. SCHMIDT, Atlas Diatom. (1904) pl. 252, fig. 21.

Valve semielliptic, arcuate. Length, 0.03 to 0.068 mm; breadth, 0.0085 to 0.0125. Costæ 3, striæ 12 in 0.01 mm. Common. Reported from Kenon and Baikal Lakes.

EPITHEMIA ZEBRA (Ehr.) Kütz. var. SAXONICA (Kütz.) Grunow.

Epithemia zebra (Ehr.) Kütz. var. *saxonica* (Kütz.) Grunow, FR. HUSTEDT, Bacillar. (1930).

Valve arcuate, with recurved ends. Length, 0.042 mm; breadth, 0.007. Costæ 4 in 0.01 mm. Common. Reported from Kenon Lake.

EPITHEMIA TURGIDA (Ehr.) Kützing.

Epithemia turgida (Ehr.) Kützing, FR. HUSTEDT, Bacillar. (1930) 387, fig. 733.

Common. Length, 0.068 mm; breadth, 0.018. A species of cosmopolitan distribution. Reported from the environs of Hailar, in the Great Khingan mountains, and from Kenon, Dalai-nor, and Baikal Lakes.

EPITHEMIA SOREX Kützing.

Epithemia sorex Kützing, FR. HUSTEDT, Bacillar. (1930) 388, fig. 736.

Valve arcuate, with capitate ends. Length, 0.45 mm; breadth, 0.015. Common. Known from the Great Khingan mountains, the environs of Hailar, and from Kenon and Baikal Lakes.

RHOPALODIA GIBBA (Ehr.) O. Müll.

Rhopalodia gibba (Ehr.) O. Müll., FR. HUSTEDT, Bacillar. (1930) 390, fig. 740.

Common. Length, 0.073 to 0.161 mm; breadth, 0.011 to 0.02. Common. Reported from the environs of Hailar, the Great Khingan mountains, and from Baikal Lake.

RHOPALODIA GIBBA (Ehr.) O. Müll. var. VENTRICOSA (Ehr.) Grunow.

Rhopalodia gibba (Ehr.) O. Müll. var. *ventricosa* (Ehr.) Grunow, FR. HUSTEDT, Bacillar. (1930) 391, fig. 741.

Smaller than the type. Length, 0.044 mm; breadth, 0.035. Infrequent. Known from fresh and brackish waters. Reported from the environs of Hailar, from Great Khingan, and Dalai-nor and Baikal Lakes.

RHOPALODIA GIBBERULA (Ehr.) O. Müll.

Rhopalodia gibberula (Ehr.) O. Müll., FR. HUSTEDT, Bacillar. (1930) 391, fig. 742.

Valve lunate, with produced and arcuate apices. Length, 0.032 mm; breadth, 0.018. Common. A brackish-water diatom.

HANTZSCHIA AMPHIOXYS (Ehr.) Grunow.

Hantzschia amphioxys (Ehr.) Grunow, FR. HUSTEDT, Bacillar. (1930) 394, fig. 747.

Valve slightly arcuate, with rostrate ends. Length, 0.04 mm; breadth, 0.007. Keel puncta 7, striæ 18 in 0.01 mm. Infrequent. Reported from Kenon and Dalai-nor Lakes.

HANTZSCHIA AMPHIOXYS (Ehr.) Grun. fo. CAPITATA O. Müll.

Hantzschia amphioxys (Ehr.) Grun. fo. *capitata* O. Müll., A. SCHMIDT, Atlas Diatom. (1921) pl. 329, figs. 13, 14.

Valve with capitate ends. Length, 0.054 mm; breadth, 0.0068. Keel puncta 6, striæ 30 in 0.01 mm. Rare.

HANTZSCHIA AMPHIOXYS (Ehr.) Grun. var. INTERMEDIA Grunow. Plate 1, fig. 5.

Hantzschia amphioxys (Ehr.) Grun. var. *intermedia* Grunow, VAN HEURCK, Synopsis (1881–1885) pl. 56, fig. 4; A. SCHMIDT, Atlas Diatom. (1921) pl. 329, fig. 4.

Valve slightly arcuate, with long, produced, subacute, ends. Length, 0.102 mm; breadth, 0.01. Keel puncta 6 to 7, striæ 14 in 0.01 mm. Common. Somewhat narrower than var. *mayor.*

HANTZSCHIA AMPHIOXYS (Ehr.) Grun. var. XEROPHILA Grunow.

Hantzschia amphioxys (Ehr.) Grun. var. *xerophila* Grunow, Diatomeen von Franz Josefs Land (1884) 47.

A form with very coarse striæ. Length, 0.04 mm; breadth, 0.0085. Keel puncta 7, striæ 30 in 0.01 mm. Rare. Reported from the environs of Hailar and from Great Khingan.

NITZSCHIA TRYBLIONELLA Hantz. var. LEVIDENSIS (W. Smith) Grunow. Plate 1, figs. 15 and 32; Plate 2, figs. 1 and 33.

Nitzschia tryblionella Hantz. var. *levidensis* (W. Smith) Grunow, FR. HUSTEDT, Bacillar. (1930) 399, fig. 760.

Valve elliptic-linear, with cuneate ends. Keel puncta extending across the valve. Length, 0.027 to 0.051 mm; breadth,

0.0085 to 0.01. Costæ 10 to 15 in 0.01 mm. Common. Known from slightly brackish water. Reported from Dalai-nor and Baikal Lakes.

NITZSCHIA ACUTA Hantzsch. Plate 2, fig. 6.

Nitzschia acuta Hantzsch, FR. HUSTEDT, Bacillar. (1930) 412, fig. 790.

Valve narrow-lanceolate, with attenuate-capitate ends. Length, 0.106 mm; breadth, 0.0043. Keel puncta 7 in 0.01 mm. Common.

NITZSCHIA RECTA Hantzsch. Plate 1, figs. 4 and 20.

Hantzschia recta Hantzsch, FR. HUSTEDT, Bacillar. (1930) 411, fig. 785.

Valve linear-lanceolate, with obtuse ends. Length, 0.064 to 0.07 mm; breadth, 0.006 to 0.0068. Keel puncta 5 to 6 in 0.01 mm. Striæ indistinct. Common.

NITZSCHIA CAPITELLATA Hust. var. SINICA Skvortzow, Plate 1, figs. 21 and 28.

Nitzschia capitellata Hust. var. *sinica* SKVORTZOW, Diatoms from environs of Soochow, Kiangsi Province, China, I, pl. 3, fig. 11.

Valve linear-lanceolate, with parallel margins in the middle and attenuate-capitate ends. Length, 0.034 to 0.06 mm; breadth, 0.0028 to 0.003. Keel puncta 11 to 12 in 0.01 mm. Striæ indistinct. Infrequent. Reported from Soochow, China.

NITZSCHIA GRACILIS Hantzsch. Plate 1, fig. 3.

Nitzschia gracilis Hantzsch, FR. HUSTEDT, Bacillar. (1930) 416, 417, fig. 794.

Abundant. Length, 0.076 mm; breadth, 0.0021. Keel puncta 15 in 0.01 mm. Smaller than the type.

NITZSCHIA PALEA (Kütz.) W. Smith. Plate 1, figs. 19 and 31.

Nitzschia palea (Kütz.) W. Smith, FR. HUSTEDT, Bacillar. (1930) 416, fig. 801.

Valve linear-lanceolate, with produced, obtuse, ends. Length, 0.037 to 0.04 mm; breadth, 0.005. Keel puncta 11 in 0.01 mm. Striæ indistinct. Common. Reported from Kenon Lake.

NITZSCHIA COMMUTATA Grunow. Plate 2, fig. 32.

Ntizschia commutata Grunow, FR. HUSTEDT, Bacillar. (1930) 405, fig. 774.

Valve constricted in the middle, with produced subrostrate ends. Length, 0.051 mm; breadth, 0.01. Keel puncta 6, striæ 20 in 0.01 mm. Infrequent. Reported from slightly brackish water.

NITZSCHIA FRUSTULUM (Kütz.) Grunow var. **PERMINUTA** Grun. Plate 1, fig. 30.

Nitzschia frustulum (Kütz.) Grunow var. *perminuta* Grun., VAN HEURCK, Synopsis (1881–1885) pl. 98, fig. 31.

Valve linear-lanceolate, with attenuate and obtuse ends. Length, 0.014 mm; breadth, 0.0025. Keel punta 9, striæ 30 in 0.01 mm. Rare. Reported from brackish water. Known from Dalai-nor Lake.

NITZSCHIA AMPHIBIA Grunow.

Nitzschia amphibia Grunow, FR. HUSTEDT, Bacillar. (1930) 414, fig. 793.

Valve linear-lanceolate, with distinct punctate striæ. Length, 0.02 mm; breadth, 0.003. Keel puncta 6, striæ 15 in 0.01 mm. Common. Reported from Baikal Lake.

NITZSCHIA SIGMOIDEA (Ehr.) W. Smith.

Nitzschia sigmoidea (Ehr.) W. Smith, FR. HUSTEDT, Bacillar. (1930) 419, fig. 810.

Valve sigmoid, with obtuse ends. Length, 0.122 to 0.29 mm; breadth, 0.0085 to 0.009. Keel puncta 5 to 8. Smaller than the type. Common.

NITZSCHIA FLEXA Schum. Plate 1, fig. 1.

Nitzschia flexa Schum., FR. HUSTEDT, Bacillar. (1930) 420, fig. 812.

Valve sigmoid, with obtuse ends. Length, 0.068 mm; breadth, 0.0029. Keel puncta 9 to 10 in 0.01 mm. Common.

NITZSCHIA ACICULARIS W. Smith. Plate 1, fig. 2.

Nitzschia acicularis W. Smith, FR. HUSTEDT, Bacillar. (1930) 423, fig. 851.

Abundant. Length, 0.035 to 0.081 mm; breadth, 0.0022 to 0.0025. Keel puncta 18 in 0.01 mm. Reported from fresh and brackish waters.

CYMATOPLEURA SOLEA (Breb.) W. Smith. Plate 1, figs. 8 and 12.

Cymatopleura solea (Breb.) W. Smith, A. SCHMIDT, Atlas Diatom. (1911) pl. 275, figs. 4–6.

Very common. Length, 0.051 to 0.17 mm; breadth, 0.008 to 0.015. Reported from the environs of Hailar, from Great Khingan, and from Kenon and Baikal Lakes.

CYMATOPLEURA SOLEA (Breb.) W. Smith var. **APICULATA** (W. Smith) Grunow.

Cymatopleura solea (Breb.) W. Smith var. *apiculata* (W. Smith) Grunow, A. SCHMIDT, Atlas Diatom. (1911) pl. 275, fig. 12.

Differs from the type in its constricted valves with apiculate ends. Common.

CYMATOPLEURA SOLEA (Breb.) W. Smith var. REGULA (Ehr.) Grunow. Plate 1, fig. 25.

Cymatopleura solea (Breb.) W. Smith var. *regula* (Ehr.) Grunow, A. SCHMIDT, Atlas Diatom. (1911) pl. 276, figs. 10, 11.

Valve linear-elliptic, with cuneate ends. Length, 0.054 mm; breadth, 0.012. Common.

CYMATOPLEURA ELLIPTICA (Breb.) W. Smith var. NOBILIS (Hantz.) Hustedt.

Cymatopleura elliptica (Breb.) W. Smith var. *nobilis* (Hantz.), FR. HUSTEDT, Bacillar. (1930) 427, fig. 828.

Valve rhombical-elliptic, with acute ends. Length, 0.16 mm; breadth, 0.08. Rare. Reported from fresh and brackish water. Known from Kenon Lake.

SURIRELLA ROBUSTA Ehr. fo. LATA Hustedt.

Surirella robusta Ehr. fo. *lata* FR. HUSTEDT, Bacillar. aus dem Aokikosee in Japan. 170, fig. 1.

Valve broad-ovate, with one end broad-rounded and the other slightly acute. Length, 0.111 mm; breadth, 0.051. Costæ 2 in 0.01 mm. Infrequent. Known from Aokiko Lake, Nippon.

SURIRELLA ROBUSTA Ehr. var. SPLENDIDA (Ehr.) Van Heurck.

Surirella robusta Ehr. var. *splendida* (Ehr.) Van Heurck, FR. HUSTEDT, Bacillar. (1930) 437, figs. 851, 852.

Valve elongate-ovate, with costæ reaching the central area. Length, 0.088 mm; breadth, 0.034. Common.

SURIRELLA BISERIATA Breb. fo. PUNCTATA Meister.

Surirella biseriata Breb. fo. *punctata* Meister, FR. HUSTEDT, Bacillar. (1930) 432, 433.

Valve linear-elliptic, with cuneate ends. Space between costæ punctate. Length, 0.088 to 0.17 mm; breadth, 0.027 to 0.037. Common.

SURIRELLA LINEARIS W. Smith.

Surirella linearis W. Smith, FR. HUSTEDT, Bacillar. (1930) 434, figs. 837, 838.

Valve linear-elliptic, with parallel margins and cuneate ends. Length, 0.088 mm; breadth, 0.027. Common. Reported from Great Khingan and Baikal Lake.

SURIRELLA LINEARIS W. Smith var. HELVETICA (Brun) Meister.

Surirella linearis W. Smith var. *helvetica* (Brun) Meister, FR. HUSTEDT, Bacillar. (1930).

Differs from the type in the presence of puncta along the median area. Length, 0.088 mm; breadth, 0.028. Infrequent.

SURIRELLA GRACILIS Grunow. Plate 2, fig. 27.

Surirella gracilis Grunow, A. SCHMIDT, Atlas Diatom. (1925) pl. 357, figs. 4–6.

Valve linear, with parallel margins and cuneate ends. Length, 0.0595 mm; breadth, 0.0085. Valve from front view slightly capitate at both ends. Infrequent. Reported from Baikal Lake.

SURIRELLA CAPRONII Brebisson.

Surirella Capronii Breb., FR. HUSTEDT, Bacillar. (1930) 440, fig. 857.

Common. Length, 0.147; breadth, 0.054. Reported from Kenon Lake.

SURIRELLA OVATA Kützing.

Surirella ovata Kützing, FR. HUSTEDT, Bacillar. (1930) 442, fig. 864.

Valve elongate-ovate. Length, 0.015 to 0.027 mm; breadth, 0.0076 to 0.011. Costæ 6 in 0.01 mm. Common. A brackish-water diatom. Reported from Kenon Lake.

SURIRELLA OVATA Kütz. var. **PINNATA** (W. Smith).

Surirella ovata Kütz. var. *pinnata* (W. Smith), FR. HUSTEDT, Bacillar. (1930) 442, fig. 865.

Valve ellipic-ovate, with one end broader than the other. Length, 0.051 mm; breadth, 0.0136. Costæ 5 in 0.01 mm. Infrequent.

SURIRELLA ANGUSTATA Kützing.

Surirella angustata Kützing, FR. HUSTEDT, Bacillar. (1930) 435, figs. 844, 845.

Valve fusiform, with cuneate ends. Length, 0.034 mm; breadth, 0.0085. Common.

SURIRELLA TIENTSINENSIS Skvortzow. Plate 2, fig. 9.

Surirella tientsinensis SKVORTZOW, Diatoms from Tientsin, North China (1927) 105, fig. 14.

Valve linear, with parallel margins and broad-capitate ends. Costæ robust, reaching the median area. Between the costæ fine, closely set, parallel, lines. Length, 0.059 mm; breadth, in the middle 12, at the broader ends 14 in 0.01 mm. Costæ 6, striæ 15 to 18 in 0.01 mm. Infrequent. A species akin to *Surirella Pantocsekii* Meister, but different. Reported from slightly brackish water in Tientsin, North China, and from Hanka Lake, Eastern Siberia.

SURIRELLA TENERA Greg.

Surirella tenera Greg., FR. HUSTEDT, Bacillar. (1930) 438, 439, fig. 853.

Valve elongate-ovate, with costæ reaching the median area. Length, 0.085 mm; breadth, 0.027. Infrequent.

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ILLUSTRATIONS

Plate 1

FIG. 1. *Nitzschia flexa* Schum.
2. *Nitzschia acicularis* W. Smith.
3. *Nitzschia gracilis* Hantz.
4. *Nitzschia recta* Hantz.
5. *Hantzschia amphioxys* (Ehr.) Grun. var. *intermedia* Grun.
6. *Neidium dubium* (Ehr.) Cleve fo. *argunensis* fo. nov.
7. *Gyrosigma acuminatum* (Kütz.) Rabh.
8. *Cymatopleura solea* (Breb.) W. Smith.
9. *Navicula argunensis* sp. nov.
10. *Cyclotella operculata* (Ag.) Kütz.
11. *Navicula gastrum* (Ehr.) Donk.
12. *Cymatopleura solea* (Breb.) W. Smith.
13. *Navicula viridula* Kütz. var. *argunensis* var. nov.
14. *Navicula placentula* (Ehr.) Grun. fo. *latiuscula* (Grun.) Meister.
15. *Nitzschia tryblionella* Hantz. var. *levidensis* (W. Smith) Grun.
16. *Navicula viridula* Kütz.
17. *Navicula viridula* Kütz. var. *rostrata* var. nov.
18. *Neidium affine* (Ehr.) Cleve fo. *hercynica* (A. Mayer) Hust.
19. *Nitzschia palea* (Kütz.) W. Smith.
20. *Nitzschia recta* Hantz.
21. *Nitzschia capitellata* Hust. var. *sinica* Skv.
22. *Diatoma anceps* (Ehr.) Grun.
23. *Navicula Reinhardtii* Grun.
24. *Epithemia zebra* (Ehr.) Kütz. var. *porcellus* (Kütz.) Grun.
25. *Cymbella solea* (Breb.) W. Smith var. *regula* (Ehr.) Grun.
26. *Neidium dubium* (Ehr.) Cleve fo. *argunensis* fo. nov.
27. *Gomphonema angustatum* (Kütz.) Rabh. var. *producta* Grun.
28. *Nitzschia capitellata* Hust. var. *sinica* Skv.
29. *Synedra parasitica* (W. Smith) var. *subconstricta* Grun.
30. *Nitzschia frustulum* (Kütz.) Grun. var. *perminuta* Grun.
31. *Nitzschia palea* (Kütz.) W. Smith.
32. *Nitzschia tryblionella* Hantz. var. *levidensis* (W. Smith) Grun.
33. *Navicula viridula* Kütz. var. *argunensis* var. nov.

FIGS. 34 and 35. *Navicula bacillum* Ehr. var. *parallela* var. nov.

FIG. 36. *Pinnularia microstauron* (Ehr.) Cleve var. *Brebissonii* (Kütz.) Hust. fo. *linearis* O. Müll.
37. *Cymbella turgidula* Grun.
38. *Navicula falaisiensis* Grun. var. *lanceola* Grun.?
39. *Frustulia vulgaris* Thw. var. *asiatica* Skv.
40. *Navicula hungarica* Grun. var. *lanceolata* var. nov.
41. *Navicula lanceolata* (Ag.) Kütz.
42. *Navicula rhynchocephala* Kütz. var. *tenua* Skv.

PLATE 2

FIG. 1. *Nitzschia tryblionella* Hantz. var. *levidensis* (W. Smith) Grun.
2. *Navicula crucicula* (W. Smith) Donk. var. *obtusata* Grun.
3. *Cymbella naviculiformis* Auersw.
4. *Cymbella naviculiformis* Auersw. fo. *constricta* fo. nov.
5. *Cymbella cuspidata* Kütz.
6. *Nitzschia acuta* Hantz.
7. *Synedra ulna* (Nitz.) Ehr. var. *lanceolata* Kütz.
8. *Stephanodiscus Hantzschii* Grun.
9. *Surirella tientsinensis* Skv.
10. *Navicula protracta* Grun.

FIGS. 11 and 12. *Pinnularia microstauron* Ehr.

FIG. 13. *Navicula pupula* Kütz. var. *rostrata* Hust.
14. *Achnanthes Biasolettiana* Kütz. Lower valve.
15. *Pinnularia viridis* (Nitz.) Ehr. var. *commutata* Grun. fo. *argunensis* fo. nov.
16. *Pinnularia microstauron* Ehr.
17. *Navicula hungarica* Grun. var. *capitata* (Ehr.) Cleve.
18. *Navicula hungarica* Grun. var. *linearis* Oestrup.
19. *Achnanthes lanceolata* Breb. var. *rostrata* Hust; lower valve.
20. *Epithemia zebra* (Ehr.) Kütz.
21. *Gomphonema lanceolatum* Ehr. forma.
22. *Epithemia zebra* (Ehr.) Kütz. var. *porcellus* (Kütz.) Grun.
23. *Navicula gastrum* (Ehr.) Donk.
24. *Caloneis Schroederi* Hust.
25. *Navicula atomus* (Naeg.) Grun.
26. *Cymbella Moelleriana* Grun.
27. *Surirella gracilis* Grun.
28. *Cymbella turgida* (Greg.) Cleve.
29. *Pinnularia isostauron* (Ehr.) Grun.
30. *Navicula viridula* Kütz.
31. *Cymbella aequalis* W. Smith.
32. *Nitzschia commutata* Grun.
33. *Nitzschia tryblionella* Hantz. var. *levidensis* (W. Smith) Grun.
34. *Pinnularia tibetana* Hust. var. *argunensis* var. nov.

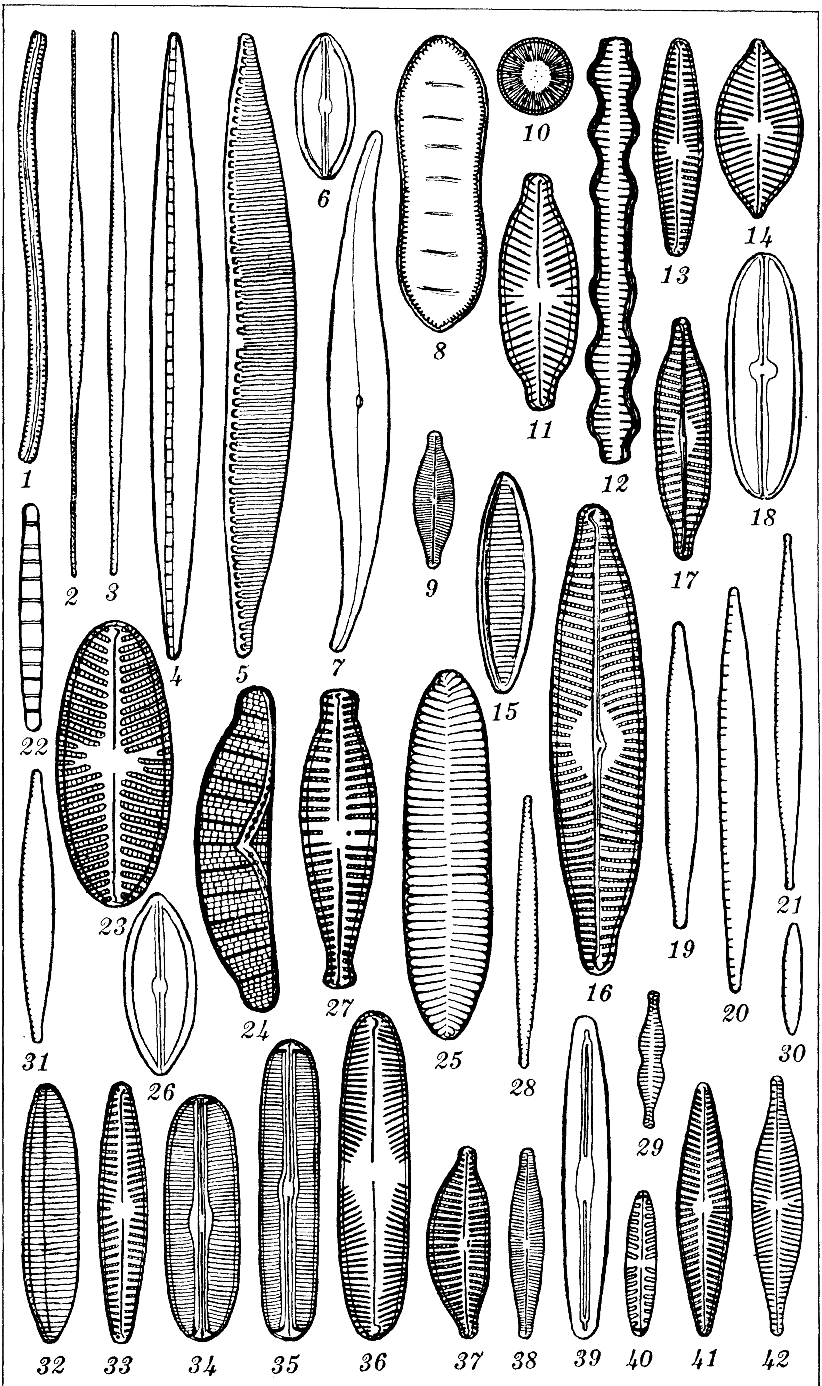
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PLATE 1.

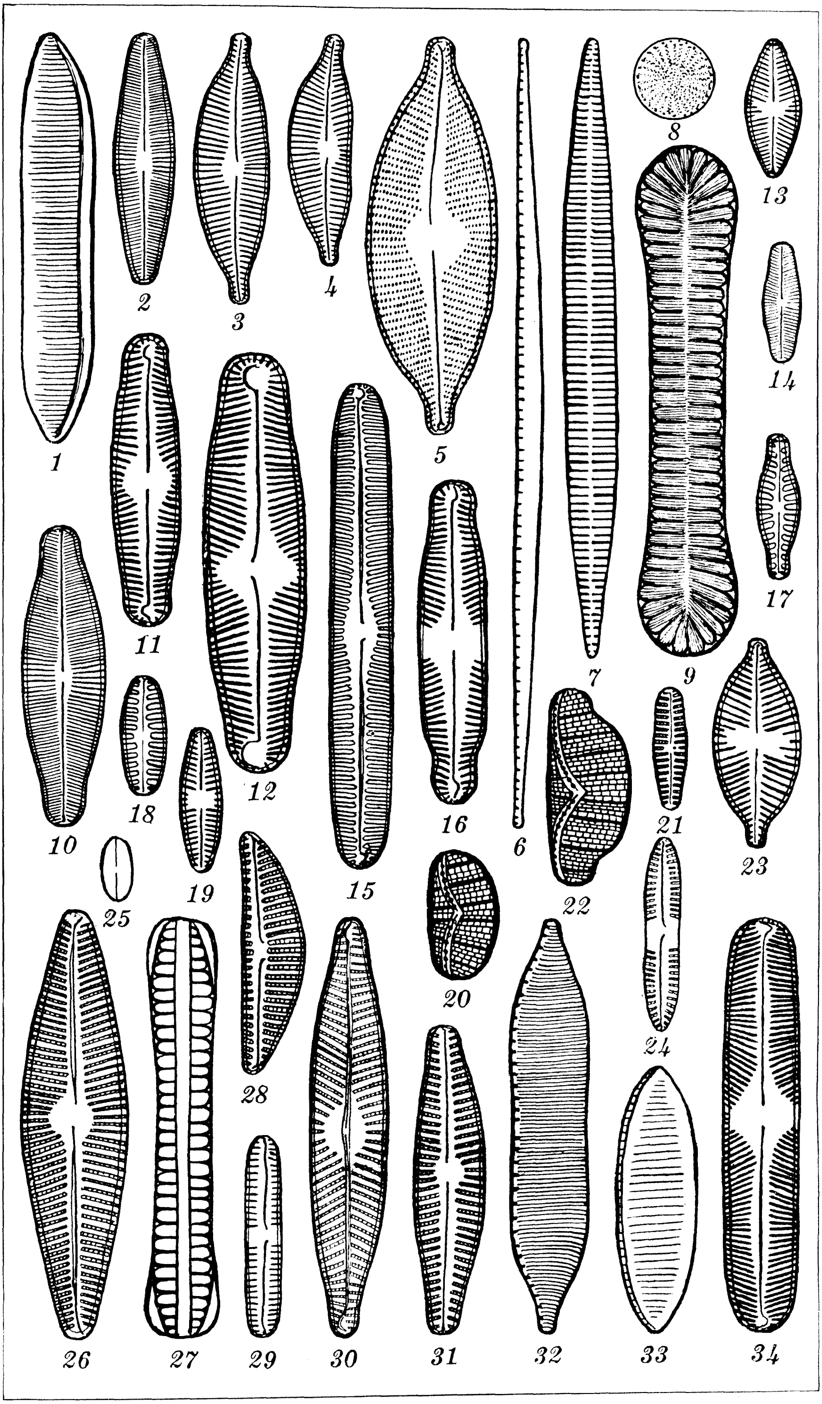
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PLATE 2.

THE EFFECT OF ARSENIC, VANADIUM, IRON, AND TIN ON THE DETERMINATION OF ANTIMONY IN HIGH-LEAD MIXTURES BY A MODIFIED PERMANGANATE METHOD.

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In a former paper (1) it was shown that antimony can be determined with a fair degree of accuracy in high-lead mixtures by a modified permanganate method. In view of the encouraging results obtained, it was decided to extend the investigation to a study of the effect of other foreign metals on the determination of antimony in high-lead mixtures. The foreign metals selected for this investigation were arsenic, vanadium, and iron, and their mixtures with tin. Separate studies were made of the effect of each of these metals on the determination of antimony, followed by combinations of two or more of them with tin.

Continued practice with the modified permanganate method showed that it could be improved by slight changes in the experimental procedure. In addition, the method was standardized by setting limits to the time of heating and to the temperatures used, and by referring all calculations of antimony found to a decinormal solution of potassium permanganate.

MODIFIED PERMANGANATE METHOD

The method as now used.—Place a gram of the high-lead mixture or alloy in a 500 cc Erlenmeyer flask and cover with a small watch glass. Add 5 grams of potassium sulphate and 15 cc of sulphuric acid. Digest the mixture at a temperature of 235° to 240° C. for 16 hours (overnight) on a hot plate. Increase the temperature to 285° or 290° C. and continue heating for 1.5 hours. Finally boil the white or nearly white liquid for 8 to 10 seconds over a Fisher burner and cool. Add 15 cc of water. Mix thoroughly and place the flask in an inclined position. The insoluble bisulphates settle out in a few minutes. Decant the nearly clear supernatant acid solution from the insoluble bisulphates into a tall lipless 400 cc Pyrex beaker. Wash with two

successive 25 cc portions of a 10 per cent tartaric-acid solution, decant, and drain as before into the beaker. Add to the total washings 10 cc of hydrochloric acid.

To the washed and drained bisulphates add 40 cc of a 33 per cent ammonium-acetate solution and digest at 75° to 80° C. until complete solution is effected. Add 30 cc of water. Again digest hot for a few minutes longer and set the flask aside.

Partially cover the beaker containing the washings with a watch glass, heat the solution to the boiling point, and pass a lively current of washed carbon dioxide through it for 1 minute to eliminate the sulphur dioxide. To the boiling hot liquid add quickly, while stirring, 10 cc of hydrochloric acid and also the prepared ammonium-acetate solution of the bisulphates contained in the Erlenmeyer flask. Wash the Erlenmeyer flask with three successive 15 cc portions of water. Add the washings to the acetate solution. Cool in ice to at least 10° C., and titrate with a standard permanganate solution.

Correct the burette reading by the use of its calibration curve for the working temperature adopted. If the solution is not decinormal, multiply the corrected volume by the normality factor. Subtract 0.06 cc for the blank and multiply the finally correct volume by 5.88 to obtain the milligrams of antimony present.

General observations on the method.—In the mixtures studied, the antimony, tin, and iron dissolve rapidly in the sulphuric-acid-bisulphate mixture. The action on the lead is peculiar. After about 20 or 30 minutes the metal becomes completely disseminated in finely suspended particles, and the liquid takes on a blue-black color. This color gradually changes to gray, and finally the liquid is nearly colorless at the end of the heating.

To insure the complete conversion of the lead and other metals to bisulphates, the digestion mixture is heated to 285° or 290° C. and finally boiled. Heating for a longer time or above the temperature prescribed is not advisable, because of the possibility of the antimony being volatilized. In general it is a safe rule to heat the mixture for no longer than is necessary to obtain a colorless or nearly colorless mixture. Actual practice shows, however, that the duration of heating and the temperatures prescribed are usually necessary.

When antimony alone or antimony and tin are converted to bisulphate, the reaction is much more easily and quickly performed than in high-lead mixtures. Less than an hour is required, and a temperature as low as 215° C. may be used.

Longer heating on the hot plate, however, does not appear to be harmful.

A much more rapid conversion of high-lead alloys or mixtures can be accomplished by immediate boiling with the sulphuric-acid-bisulphate mixture. This procedure is used by Robinson.(2) In our experience, however, considerable free sulphur condenses on the colder neck of the flask. If this is not completely removed (a troublesome operation) it can cause high permanganate readings. The slower method is therefore to be preferred.

A convenient device for more rapidly bringing about the solution of the lead and other bisulphates (usually in hard crusts) in the hot ammonium acetate solution is to grind the crystals under the flat surface of the flared end of a stout glass stirring rod. By this means complete solution of the bisulphates can be effected in a few minutes.

A tall lipless 400 cc beaker for the washings and the final titration with permanganate solution has two distinct advantages over the 500 cc Erlenmeyer flask formerly used. A better mixing of the washings and the ammonium acetate solution of the bisulphates is effected, and the subsequent titration with permanganate is much more easily and accurately carried out.

Usually no immediate reprecipitation of the lead bisulphate takes place when the acetate solution is added to the boiling hot hydrochloric- and tartaric-acid mixture. Reprecipitation occurs after the cold and final washings are added. The advantage of double precipitation is therefore increased, because of the greater solubility of the formerly occluded antimony bisulphate by dilution. When the percentage of the lead is 95 or more, some precipitation does take place before dilution. The washed, ignited, and recovered precipitates after the permanganate titration were found to be variable mixtures consisting chiefly of lead sulphate (60 per cent and over), lead chloride, and some acetate.

In order to obtain sharp end points, a lively current of washed carbon dioxide is passed through the boiling liquid. This additional procedure is very effective in eliminating the sulphur dioxide which interferes with satisfactory readings, and as a result the end points are always sharp and can be easily obtained. The presence of the finely divided suspension of lead bisulphate has a distinct advantage also in this particular.

All procedures after the conversion of the metals to bisulphates should be carried out as rapidly as possible.

The final volume of the solution to be titrated is approximately 210 cubic centimeters. This conforms to the volume used in the standard permanganate method before titration.

Standardization.—By calculating the antimony equivalent for 1 cubic centimeter of strictly decinormal permanganate solution all analyses for antimony are greatly simplified. Only the normality of the solution is required, and this can be quickly and accurately determined by the McBride or sodium-oxalate method.

All standardizations recorded in this paper were made by using 200 to 300 milligrams of antimony and adding enough lead to increase the total weight of the metals to 1 gram. With 250 to 300 milligrams of antimony, more than 42 cubic centimeters of permanganate solution are required, which is not desirable and involves the danger that secondary reactions between the hydrochloric acid and the permanganate solution might take place from the undue heating of the solution titrated. It was therefore decided to base the standardization chiefly on the lower amounts of antimony used. Table 1 is a summary of the standardizations made, showing milligrams of antimony and lead used, temperatures and time on hot plate, cc of permanganate solution used, and mgs of antimony found.

TABLE 1.—*Standardization of 0.1N permanganate solution in terms of antimony per cubic centimeter of solution at 30° C.*

[NOTE.—According to the equation: $5SbCl_3 + 2KMnO_4 + 16MCl = 5SbCl_5 + 2KCl + 2MnCl_2 + 8H_2O$, 1 cc of 0.1*N* permanganate solution theoretically is equivalent to 6.088 mg antimony. The average of standardizations 1, 2, and 3 gives an antimony equivalent to 5.92 mg for 1 cc of 0.1*N* permanganate solution at 30° C. by the standard permanganate method.]

Standardization No.	Antimony.	Lead.	Temperature.	Time.	Volume of 0.1*N* $KMnO_4$ at 30°C.	Antimony equivalent per cc. at 30°C.
	mg.	*mg.*	°*C.*	*Hrs.*	*cc.*	*mg.*
1	200	0	215–220	3–4	33.78	[a] 5.92
2	200	0	235–240	2–3	33.74	[a] 5.93
3	200	0	235–240	2–3	33.77	[a] 5.92
4	200	0	235–240	3–4	34.18	5.86
5	200	0	235–240	16	34.18	5.85
6	300	700	235–240	16	51.26	5.85
7	250	750	235–240	16	42.43	[c] 5.92
8	250	750	235–240	16	42.61	[c] 5.87
9	200	800	235–240	16	34.03	[c] 5.87
10	200	800	[b] 235–240	16	34.12	[c] 5.86
11	200	800	[b] 235–240	16	33.76	[c] 5.92
12	200	800	[b] 235–240	16	33.99	[c] 5.88

[a] The standard permanganate method was used. All the other standardizations were by the modified permanganate method.

[b] Temperature increased to 285° or 290° C. and continued for 1.5 hours.

[c] The residues were boiled over a Fisher flame from 6 to 8 seconds. Finally a lively current of washed carbon dioxide was passed through the boiling washings for 1 minute.

Disregarding the rather low standardization 6, and averaging standardizations 7 to 12 inclusive, the antimony equivalent for 1 cc of $0.1N$ permanganate solution at 30° C. is 5.886 mg. In round numbers the equivalent is therefore between 5.88 and 5.89 mg. The more conservative value 5.88 was selected.

In standardizations 6, 7, and 8, the calculated volumes of $0.1N$ permanganate solution for 200 mg of antimony were 34.16, 33.95, and 34.08 cc, respectively.

A temperature correction for 30° C. was made for all burette readings. In addition a blank correction was made also for impurities in the lead that consumed the permanganate solution. The average of three blank determinations very carefully made with 200 mg of lead and by the modified procedure gave a value of 0.059 cc, or, in round numbers, 0.06 cc, of $0.1N$ permanganate at 30° C.

Influence of hydrochloric acid.—F. Kessler(3) first described the standard permanganate method and, according to R. Fresenius(4) determined accurately the conditions under which antimony in acid solution may be satisfactorily titrated. He limited the hydrochloric acid (specific gravity 1.18 to 1.19) to not less than 10.3 and not over 20.5 per cent by volume. Using acid of about the same specific gravity, Hillebrand and Lundell(5) state that "hydrochloric acid is essential for rapid and complete oxidation of antimony by permanganate and its amount should not be less than 10 per cent nor more than 25 per cent by volume." In respect to sulphuric acid, they add, "it is also desirable in amounts approximately 10 per cent by volume." However, the concentration by volume of hydrochloric acid (specific gravity 1.18 to 1.19) used by Treadwell and Hall(6) in their description of the standard permanganate method is 9.5 per cent. The procedure is similar to that recommended by the United States Bureau of Standards. The concentration by volume of hydrochloric acid (specific gravity 1.18 to 1.19) in the modified permanganate method was also made to conform to 9.5 per cent, that of the sulphuric acid being 7.1 per cent. These percentages are decidedly under the lower limits set by Kessler, and those of Hillebrand and Lundell.

The theoretical equivalent of antimony for 1 cc of a decinormal permanganate solution is 6.088 mg. For the standard and modified permanganate methods the equivalents for 1 cc of permanganate solution are 5.923 and 5.886 mg of antimony respectively.

Incidentally an experimental study was made of the influence of different concentrations of hydrochloric acid on the antimony equivalent as determined by the modified and standard permanganate methods. The concentrations of hydrochloric acid used ranged from 9.5 per cent (that employed in the Treadwell and Hall procedure) to 19.0 per cent. Those concentrations above 9.5 per cent, as noted, are favored by Kessler and by Hillebrand and Lundell.

Tables 2 and 3 summarize the results of the experiments made and show that the antimony equivalent increases with the concentration of hydrochloric acid used, though the increase is not strictly proportional.

TABLE 2.—*Influence of increasing concentrations of hydrochloric acid in the modified permanganate method on the antimony equivalent of 0.1N permanganate solution at 30° C.*

[NOTE.—Procedure same as that used for the antimony equivalents in Table 1. Concentrations of hydrochloric acid calculated in volume per cent. Temperature of solution at the beginning of titration 5° C.; at the end, 14° C.]

Experiment No.	Antimony.	Lead.	Hydrochloric acid concentration.	Antimony equivalent per cc.
	mg.	*mg.*	*Per cent.*	*mg.*
1	250.0	750.0	9.5	[a] 5.861
2	250.0	750.0	11.9	5.914
3	250.0	750.0	14.2	[a] 6.000
4	250.0	750.0	16.6	[b] 6.012
5	250.0	750.0	19.0	[b] 6.039

[a] Duplicate determinations made. [b] End point evanescent.

TABLE 3.—*Influence of increasing concentrations of hydrochloric acid in the standard permanganate method on the antimony equivalent of 0.1N permanganate solution at 30° C.*

[NOTE.—Procedure same as that used for the antimony equivalents in Table 1. Concentrations of hydrochloric acid calculated in volume per cent. Theoretical value of 1 cc 0.1*N* $KMnO_4$=6.088 mg Sb. Temperature of solution at the beginning of titration 5° C.; at the end, 14° C.]

Experiment No.	Antimony.	Tin.	Hydrochloric acid concentration.	Antimony equivalent per cc.
	mg.	*mg.*	*Per cent.*	*mg.*
1	200.0	200.0	9.5	5.925
2	200.0	200.0	11.9	5.961
3	200.0	290.0	14.2	5.989
4	200.0	200.0	16.6	[a] 6.002

[a] End point evanescent.

It is probable that small amounts of antimony are volatilized in the modified permanganate method. At any rate this possibility is always present in boiling hot and more highly concentrated hydrochloric acid solutions. For that reason it was decided to adhere to the 9.5 per cent concentration of the acid, and in strict agreement with the Treadwell and Hall procedure for the standard permanganate method. Finally the continued use of this procedure in recent years by many chemists indicates strongly that its accuracy is satisfactory.

Apparatus and chemicals.—Two acid burettes were used for the titrations. One of these was a 50 cc burette graduated in 0.1 cc at 27.5° C., and the other a 10 cc microburette graduated in 0.01 cc at 27.5° C., and inspected by the Physicalisch-Technische Reichsanstalt.

Both burettes were carefully calibrated at the average working temperature of 30° C.

The antimony, tin, and lead used were the pure "analysed" grade, manufactured by Baker and Company. Arsenic, as arsenious acid, Standard Sample No. 83, was prepared by the United States Bureau of Standards. Vanadium, as vanadic acid (V_2O_5), was manufactured by Kahlbaum. Iron in the form of iron wire was of the C. P. grade and contained 99.8 per cent of the metal.

All the other chemicals used were of the C. P. "analysed" grade.

Whenever acids are mentioned in this paper the following concentrations were employed: Hydrochloric acid, concentrated, specific gravity 1.18; sulphuric acid, concentrated, specific gravity 1.84.

In all solutions used the percentage concentration was by weight. In respect to the ammonium-acetate solution 1 pound of the pure salt dissolved in 922 cc of water gives approximately the desired concentration of 33 per cent by weight. The specific gravity of this solution at 15.6° C. is 1.059 to 1.060.

EXPERIMENTAL RESULTS

The effect of arsenic.—During the conversion of the antimony, lead, and other metals to bisulphates by the modified permanganate method, the arsenic remains in its trivalent form—probably as arsenious acid. In the subsequent titration with permanganate solution both the trivalent arsenic and the antimony are oxidized to their quinquevalent forms. The effect of

the arsenic is therefore positive, and higher results for the antimony are obtained.

No simple procedure is known at present for the selective oxidation of the arsenic in the presence of antimony. Neither can the arsenic be completely volatilized, even at the temperatures of 235° C. and higher that prevail in the method. A correction is therefore necessary. The correction is made by multiplying the milligrams of arsenic known to be present by some factor and subtracting the product from the apparent antimony reading.

In the standard permanganate method Hillebrand and Lundell(5) use the factor 1.86. However, this is too high, because some of the arsenic is volatilized at the temperatures above 200° C. used in the modified permanganate method.

Six careful determinations of antimony were made in which varying quantities of arsenic were taken, and a new factor, 1.66, was calculated. If the arsenic does not exceed 1 per cent of the antimony present no correction is necessary, as shown by many repeated observations.

Table 4 is a summary of the effect of arsenic on antimony in high-lead mixtures. The limits of the antimony range from

TABLE 4.—*Effect of arsenic on the determination of antimony in high-lead mixtures.*

Sample No.	Mixture.			Antimony found.	Error.
	Base metal.	Foreign metal.	Antimony used.		
	Lead.	Arsenic.			
	mg.	*mg.*	*mg.*	*mg.*	*Per cent.*
1	972.5	2.5	25.0	24.3	—2.8
2	944.7	5.2	50.1	49.4	—1.4
3	944.9	5.0	50.1	49.1	—2.0
4	899.5	0.5	100.0	99.7	—0.3
5	899.5	0.5	100.0	99.6	—0.4
6	899.4	0.6	100.0	99.4	—0.6
7	899.2	0.8	100.0	99.4	—0.6
8	898.8	1.0	100.2	99.2	—1.0
9	899.0	1.0	100.0	100.2	+0.2
10	899.0	1.0	100.0	100.8	+0.8
11	898.5	1.4	100.0	99.2	—0.8
12	897.0	2.5	100.5	99.6	—1.2
13	894.9	5.0	100.1	100.1	0.0
14	895.0	5.0	100.0	100.5	+0.5
15	890.0	10.0	100.0	100.5	+0.5
16	799.0	1.0	200.0	199.5	—0.3

NOTE.—The arsenic correction 1.66 was used only when the ratio of the arsenic to the antimony was greater than 1:100. A microburette calibrated at 30°C. was used for samples 1, 2, and 3.

25 to 200 mgs, or from 2.5 to 20 per cent of the total metal used.

Table 4 shows that (*a*) the percentage of error is less than 1 in most of the experiments, the average being 0.4, if sample 1 is excluded; (*b*) the percentage of error tends to increase as the amount of antimony is decreased to 50 and 25 mgs; and (*c*) the precision is good.

The effect of vanadium.—The effect of vanadium on the determination of antimony is a negative one, and is therefore the opposite to that of arsenic. Rather low results were obtained in all the experiments. This finding is not in agreement with the general properties of vanadium.

Vanadium as vanadic acid (V_2O_5) is reduced to the green trivalent form during the action of hot sulphuric acid on the high-lead mixtures. Theoretically at least, trivalent or quadrivalent vanadium should be oxidized to the quinquevalent form after subsequent dilution and titration with permanganate solution. In this regard a well-known volumetric method confirms this principle in practice.

It was thought that possibly the ammonium acetate in some way prevented the oxidation of trivalent vanadium, and at the same time interfered with the more accurate determination of the antimony by the modified permanganate method. In order to test this point, two experiments were made on the determination of the antimony in the presence of vanadium as vanadic acid (V_2O_5) by the standard permanganate method, in which, of course, no ammonium acetate is used. For the first experiment 100 mgs of antimony and 100 mgs of tin were mixed with 10 mgs, and in the second experiment with 5 mgs, of vanadium as vanadic acid (V_2O_5).

These experiments were quite similar to samples 8 and 9 in Table 5, differing only in that tin was substituted (but in smaller quantity) for the lead.

The findings were interesting. In the experiment with 10 mgs of vanadium the percentage of error was +2.3, in that with 5 mgs, +0.9. The results are in striking contrast to those from samples 8 and 9, Table 5, where the modified permanganate method was used, and in which the percentage of error for both was — 2.5.

It is highly probable, therefore, that ammonium acetate does exert a disturbing effect on the determination of antimony when vanadium is present.

Table 5 is a summary of the effects of vanadium on the determination of antimony by the modified permanganate method.

TABLE 5.—*Effect of vanadium on the determination of antimony in high-lead mixtures.*

Sample No.	Mixture.			Antimony found.	Error.
	Base metal.	Foreign metal.	Antimony used.		
	Lead.	Vanadium.			
	mg.	*mg.*	*mg.*	*mg.*	*Per cent.*
1	973.5	1.5	25.0	24.5	—2.0
2	972.5	2.5	25.0	24.9	—0.6
3	947.5	2.5	50.0	48.4	—3.2
4	945.0	5.0	50.0	49.4	—1.2
5	897.5	2.5	100.0	98.1	—1.9
6	897.5	2.5	100.0	95.4	—4.6
7	895.0	5.0	100.0	98.0	—2.0
8	895.0	5.0	100.0	97.5	—2.5
9	890.0	10.0	100.0	97.8	—2.5
10	790.0	10.0	200.0	187.2	—6.4
11	790.0	10.0	200.0	190.7	—4.6

NOTE.—The results for "Antimony found" are given without correction. A microburette calibrated at 30° C. was used for samples 1, 2, 3, and 4.

Table 5 shows that (*a*) the percentage of error in most of the experiments is fairly close to 2, and (*b*) that the results tend to be erratic.

The effect of iron.—In the determination of antimony, iron acts very similarly to vanadium. The negative effect is followed by rather low results in all the experiments made, which is contrary to usual experience. Theoretically, at least, in the hot sulphuric acid high-lead mixtures iron would be reduced to the divalent form. During the subsequent dilutions, boiling temperatures, and frequent exposure to air, most of the divalent iron becomes oxidized to its trivalent form. The tendency would be toward slightly higher results than the amount of antimony actually present. However, in the actual analysis of bearing metal for antimony by the standard permanganate method small amounts of iron do not interfere. Therefore the presence of small amounts of iron should cause no especial difficulty in the determination of antimony by the use of either method. Divalent iron differs from trivalent or quadrivalent vanadium in these respects.

It is highly probable that ammonium acetate, as in the vanadium experiments, acts with the iron in an adverse manner on the determination of antimony.

In respect to the iron, however, the percentage of error in a negative way is fairly even, and in most of the experiments approximates 2. So that if the antimony readings are multiplied by 6, that is, 5.88 × 1.02, the per cent of error is less than 1.

Table 6 is a summary of the effects of iron on the determination of antimony by the modified permanganate method. The percentages of error are not corrected.

TABLE 6.—*Effect of iron on the determination of antimony in high-lead mixtures.*

Sample No.	Mixture.			Antimony found.	Error.
	Base metal.	Foreign metal.	Antimony used.		
	Lead.	Iron.			
	mg.	*mg.*	*mg.*	*mg.*	*Per cent.*
1	972.5	2.5	25.0	24.4	—2.6
2	947.5	2.5	50.0	48.6	—2.8
3	945.0	5.0	50.0	49.1	—1.8
4	939.8	10.2	50.0	48.9	—2.2
5	897.5	2.5	100.2	97.8	—2.2
6	897.0	2.4	100.0	97.6	—2.4
7	895.0	5.0	100.0	98.5	—1.5
8	895.0	5.1	100.2	97.6	—2.4
9	890.0	10.0	100.0	98.2	—1.8
10	890.4	10.1	100.2	97.7	—2.5
11	790.0	10.0	200.0	198.1	—1.0

NOTE.—A microburette calibrated at 30° C. was used for samples 1, 2, 3, and 4.

TABLE 7.—*Effect of iron on the determination of antimony in high-lead mixtures.*

Sample No.	Mixture.			Antimony found.	Error.
	Base metal.	Foreign metal.	Antimony used.		
	Lead.	Iron.			
	mg.	*mg.*	*mg.*	*mg.*	*Per cent.*
1	972.5	2.5	25.0	24.9	—0.4
2	947.5	2.5	50.0	49.6	—0.8
3	945.0	5.0	50.0	50.1	+0.2
4	939.8	10.2	50.0	49.9	—0.2
5	897.5	2.5	100.2	99.8	—0.2
6	897.0	2.4	100.0	99.6	—0.4
7	895.0	5.0	100.0	100.5	+0.5
8	895.0	5.1	100.2	99.6	—0.4
9	890.0	10.0	100.0	100.2	+0.2
10	890.4	10.1	100.2	99.7	—0.3
11	790.0	10.0	200.0	198.1	+1.0

NOTE.—The mgs of "Antimony found" in the table above are obtained by multiplying those in Table 6 by the factor 1.02.

A microburette calibrated at 30° C. was used for samples 1, 2, 3, and 4.

Table 7 is a repetition of Table 6, but with the amounts of antimony found corrected after multiplying by the factor 6.

Tables 6 and 7 show that (*a*) the actual per cent of error is quite uniform, even when considerable variation exists in the amounts of antimony and iron taken; (*b*) precision is excellent; and (*c*) if the factor 6 is used, the percentage of error is less than 1.

The effect of arsenic and iron.—Table 8 shows pretty convincingly that the effects of the arsenic and iron are additive. In other words, the normally high burette readings for the arsenic are compensated by the low readings for the iron.

TABLE 8.—*Effect of arsenic and iron on the determination of antimony in high-lead mixtures.*

[NOTE.—Since, according to Tables 6 and 7, iron averages 2.0 per cent too low, a correction can be introduced by multiplying the milligrams of antimony found by 1.02 or the corrected burette reading by (5.88 x 1.02) or 6. In the table above this is done first and the arsenic correction then applied, as in *b*.]

Sample No.	Mixture.				Antimony found.		Error.	
	Base metal.	Foreign metals.		Antimony used.				
	Lead.	Arsenic.	Iron.		*a*.	*b*.	*a*.	*b*.
	mg.	*mg.*	*mg.*	*mg.*	*mg.*	*mg.*	*Per cent.*	*Per cent.*
1	945.0	2.5	2.5	50.0	49.0	50.1	—2.0	+0.2
2	940.0	5.0	5.0	50.0	49.3	50.2	—1.4	+0.4
3	895.0	2.5	2.5	100.0	98.3	100.4	—1.7	+0.4
4	890.0	5.0	5.0	100.0	99.0	101.1	—1.0	+1.1
5	880.0	10.0	10.0	100.0	98.1	100.4	—1.9	+0.4
6	880.0	10.0	10.0	100.0	96.2	98.5	—3.8	—1.5
7	845.0	2.5	2.5	150.0	145.4	148.5	—3.0	—1.0
8	795.0	2.5	2.5	200.0	196.0	200.0	—2.0	0.0
9	782.7	10.0	5.7	201.6	202.1	206.6	+0.3	+2.5

[a] "Antimony found" and its percentage of error is obtained by the arsenic correction only.

[b] "Antimony found" and its percentage of error is obtained by combining the iron and arsenic corrections.

The "Antimony found" and the percentage of error calculated in column *a* in Table 8 were obtained by the use of the arsenic correction alone. With the exception of sample 9 all percentages of error are negative.

The "Antimony found" and the percentage of error calculated in column *b* were obtained by combining the arsenic and antimony corrections. With the exception of samples 4 and 9 the percentages of error are close to 1 or slightly less. The

maximum percentage of negative error observed was 1.5 for sample 6 where relatively large amounts of arsenic and iron were present.

In practice the combined arsenic and iron correction is obtained by first multiplying the final antimony reading by 6 (approximately the product of the standard antimony equivalent 5.88 by 1.02, Table 7), and subtracting from this the product of mgs of arsenic present by 1.66, Table 4.

The precision observed in samples 5 and 6 is only fair. The conclusion is well supported that the combined arsenic and iron correction gives more satisfactory results than the arsenic correction alone.

The effect of arsenic, iron, and tin.—The effect of arsenic, iron, and tin on the determination of antimony in high-lead mixtures is complicated. If the combined arsenic and iron correction is used, the percentages of error show an erratic tendency. Evidently the tin has some disturbing effect on the iron. For this reason it was decided to apply the arsenic correction only. The correction was disregarded, however, when the ratio of the arsenic to the antimony was less than 1:100.

Table 9 is a summary of the results obtained.

TABLE 9.—*Effect of arsenic, iron, and tin on the determination of antimony in high-lead mixtures.*

Sample No.	Mixture.					Antimony found.	Error.
	Base metal.	Foreign metals.			Antimony used.		
	Lead.	Arsenic.	Iron.	Tin.			
	mg.	*mg.*	*mg.*	*mg.*	*mg.*	*mg.*	*Per cent.*
1	977.5	1.0	1.0	0.5	20.0	19.4	—3.0
2	972.5	1.0	1.0	0.5	25.0	24.3	—2.8
3	937.5	2.5	2.0	1.0	50.0	49.6	—0.7
4	916.5	2.0	6.0	5.0	75.0	74.8	—0.3
5	887.5	5.0	2.5	5.0	100.0	98.3	—1.8
6	887.5	5.0	2.5	5.0	100.0	98.5	—1.5
7	802.5	5.0	2.5	10.0	180.0	180.2	+0.1
8	746.0	0.5	2.5	1.0	250.0	250.1	+0.04

NOTE.—The arsenic correction alone was used, and this only when the ratio of the arsenic to the antimony was greater than 1 : 100.

A microburette calibrated at 30° C. was used for samples 1, 2, and 3.

The highest percentages of negative error obtained (— 2.8 and — 3) are confined to those experiments in which the anti-

mony is low. This result, in general, agrees with the results obtained with the other experimental mixtures under similar conditions.

When the antimony is increased, the percentage of error is considerably diminished, and is usually less than 1. In respect to samples 5 and 6 precision is good.

The effect of arsenic, vanadium, iron, and tin.—The effect of arsenic, vanadium, iron, and tin on the determination of antimony is shown in Table 10.

TABLE 10.—*Effect of arsenic, vanadium, iron, and tin on the determination of antimony in high-lead mixtures.*

Sample No.	Mixture.						Antimony found.	Error.
	Base metal.	Foreign metals.				Antimony used.		
	Lead.	Arsenic.	Vanadium.	Iron.	Tin.			
	mg.	*mg.*	*mg.*	*mg.*	*mg.*	*mg.*	*mg.*	*Per cent.*
1	988.0	2.0	1.0	2.0	2.0	5.0	4.8	—4.0
2	986.5	1.0	0.5	1.0	1.0	10.0	10.4	+4.3
3	968.0	2.0	1.0	2.0	2.0	25.0	24.2	—3.2
4	943.7	1.2	0.5	2.5	1.1	50.0	49.3	—1.7
5	873.0	10.0	2.0	5.0	10.0	100.0	99.0	—1.0
6	895.5	1.0	0.5	2.0	1.0	100.0	98.3	—1.7
7	844.3	1.5	0.2	2.5	1.5	150.0	149.6	—0.3
8	820.0	1.5	0.5	2.0	1.0	175.0	175.5	+0.3
9	793.3	2.5	0.2	2.0	2.0	200.0	195.7	—1.7
10	745.0	1.0	0.5	2.5	1.0	250.0	247.7	—0.9

NOTE.—The arsenic correction alone was used, and this only when the ratio of the antimony to the arsenic was greater than 1 : 100.

A microburette calibrated at 30° C. was used for samples 1, 2, 3, and 4.

On account of the increased complications in the mixtures studied it was found impossible to arrive at any satisfactory correction for the vanadium and iron. In a general way, however, these metals do not seem to exert any major effect on the determination of antimony under the experimental conditions present. A correction for the arsenic alone was made, therefore, when its proportion to the antimony was greater than 1 : 100.

With the exception of those experiments in which the antimony was low, the highest per cent of error was not over — 1.7.

DISCUSSION OF RESULTS

All determinations of antimony made by the use of a standard solution of potassium permanganate are referred to the decinormal concentration at 30° C. The average of six careful

standardizations gives a value of 5.886 milligrams of antimony for the equivalent of 1 cubic centimeter of the standard solution. The rounded and more conservative value of 5.88 is used here. In respect to the standard permanganate method the antimony equivalent per cubic centimeter is 5.92. By means of these constants, the determination of antimony is greatly simplified. Only the normality of the permanganate solution is required, and this can be easily and accurately determined by the McBride or sodium-oxalate method.

The possibility of losses of antimony from the boiling hot hydrochloric acid solutions used in the modified permanganate method was pointed out. The 9.5 percentage concentration of hydrochloric acid is therefore to be preferred. The continued use of this concentration according to the Treadwell and Hall procedure in the standard permanganate method supports this choice.

Seven tables are given showing the effects of arsenic, vanadium, and iron, and their admixtures with tin, on the determination of antimony by the modified permanganate method.

The effect of arsenic on the determination of antimony is to give high results. Above 200° C. in sulphuric acid solutions small amounts of arsenic are volatilized. However, the arsenic cannot be completely volatilized or selectively oxidized without disturbing the antimony, and hence a correction is necessary. The milligrams of arsenic present multiplied by the empirical factor 1.66 were therefore subtracted from all antimony readings when the arsenic was greater than 1 : 100. With this correction the per cent of error in most of the experiments was less than 1, and precision fair.

Vanadium acts in a peculiar way. Its general effect on antimony determinations is to give low results, possibly due to the presence of ammonium acetate. In addition, when vanadium is over 2 : 1000 in the lead antimony mixtures it acts as a positive catalyst, the complete conversion of the lead and other metals to bisulphates requiring in many instances not over an hour or two. The percentage of error in the mixtures studied ranged from 0.6 to 6.4, the average being about 2.8 per cent, which is higher than desirable. There is also an erratic tendency shown, and precision is only fair. On account of the variable effect of vanadium no correction was made.

When iron is introduced into lead-antimony mixtures, the effect on the determination of antimony is to give low results. This effect is similar to that of vanadium, as noted. However,

the low results from iron show a uniformity even when there is considerable variation in it and also in the antimony. A correction is therefore introduced, by multiplying the milligrams of antimony found by the factor 1.02, or, much more simply, the final burette readings by 6.00; that is, 1.02×5.88. When this is done the percentage of error in all but one of the experiments is less than 1. The highest percentage of error is 1. Precision is good. Tables 6 and 7 show the antimony found, without and with corrections.

If arsenic and iron are added to the lead-antimony mixture, the effect is approximately additive, as shown in Table 8. In all but two of the experiments there is a decided reduction in the percentage of error which averages less than 1. An exception to be noted is the experimental mixture 9, in which the percentage of error for the combined correction is + 2.5, compared to + 0.3 when the arsenic correction alone is used. The negative effect of the error appears to be considerably lessened, as the milligrams of antimony increase to the 200 milligram limit. In this case precision is fair. The combined correction is made by multiplying the final burette reading by 6 and then applying the correction for arsenic; that is, (B. R. $\times$ 6)—1.66 mg As.

When the investigation was extended to include tin, and finally vanadium, with arsenic and iron the complications naturally increase. It is possible that tin tends to reduce the negative effect of the iron and vanadium on the antimony determination in some manner, since erratic results are obtained when the combined arsenic and iron correction are applied. On account of this finding only the arsenic correction is used. In most of the experimental mixtures the percentage of error is considerably less than 2, but increases to a little over 4 when the antimony is reduced to the lower limits of 10 and 5 milligrams. Precision is good in the tin admixture table (Table 9).

To a certain extent the correction for arsenic and iron required by the method may be considered objectionable, since separate determinations of these should be made if greater accuracy is desired. However, in view of the fact that the modified permanganate method is direct, requires only 1 gram of metal, few chemicals, and the simplest apparatus, it would seem that the correction objection is not a serious one. The further fact that in high-lead alloys similar in kind to the mixtures experi-

mented with, special devices must be used to eliminate the large quantities of lead present, also should be considered. A final advantage lies in the relatively short time required (about 90 minutes after the conversion of the metals to sulphates) to complete the antimony determination.

The effects of bismuth, copper, cadmium, and zinc on the determination of antimony by the modified permanganate method were not investigated. These metals are very stable in solution to oxidizing agents. In addition they occur in small quantities in antifriction metal, many analyses of which have been made for antimony by the standard permanganate method. So far no interferences have been observed. Therefore it is highly probable that bismuth, copper, cadmium, and zinc in small quantities exert no objectionable effects on the modified permanganate method.

SUMMARY

A modified permanganate method has been described for the determination of antimony in high-lead mixtures.

Results showing the effects of foreign metals on the application of the modified permanganate method have been obtained.

The particular foreign metals employed in the investigation were arsenic, vanadium, and iron. Admixtures of these metals with tin were also used.

The modified permanganate method has been used successfully for the determination of antimony in high-lead mixtures.

The method was tested rigorously between the limits of 0.5 and 25 per cent for antimony and 75.5 to 98.8 per cent for lead. The maximum percentage of the foreign metals, arsenic, vanadium, iron, and tin was 1.

For high-lead mixtures or alloys the method is quite rapid, as it requires only about 90 minutes after the conversion of the metals to bisulphates.

The method is quite satisfactory, since it avoids the use of special apparatus and the tedious sulphide separation.

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NEW OR LITTLE-KNOWN TIPULIDÆ FROM EASTERN ASIA (DIPTERA), XXXVI [1]

By CHARLES P. ALEXANDER
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THREE PLATES

The crane flies discussed in this paper were included in extensive shipments of these flies received from Japan and Formosa, collected by Messrs. Takeo Kato, Hiromu Yamamoto, and Ryoichi Takahashi; from southeastern China, taken by Mr. J. Linsley Gressitt and Mr. Ernest R. Tinkham, together with additional materials taken by a native collector employed by Mr. Tinkham; and from Sumatra and Java, collected by Mrs. M. E. Walsh. All of the types are preserved in my collection of these flies, and I wish to express my very deepest thanks to all of the above-mentioned entomologists for their continued interest in saving these flies which are too often ignored by collectors of insect specimens.

TIPULINÆ

PLOCIMAS MAGNIFICUS Enderlein. Plate 1, fig. 1; Plate 2, fig. 25.

Plocimas magnificus ENDERLEIN, Zool. Anzeig. 52 (1921) 226, 227.

Enderlein described this beautiful fly from both sexes, the specimens being taken at and near Canton, Kwangtung, China, in 1911 by von Mell. One female, Hong San, southeastern Kiangsi, altitude 3,000 feet, June 22, 1936 (*Gressitt*).

The specimen differs in some regards from the type description.

Female.—Length, about 35 millimeters; wing, 22.5.

Outer segments of palpi black. Frontal prolongation of head elongate, much as in the genus *Clytocosmus* Skuse, but with a distinct nasus. Intermediate præscutal stripes paler at cephalic ends. Each scutal lobe with two dark areas; these, like the præscutal stripes, subnitidous, narrowly bordered by more opaque brown; præscutal interspaces with sparse setæ; lateral portions of scutal lobes with long erect black setæ; scutellum

[1] Contribution from the Department of Entomology, Massachusetts State College.

with long coarse golden setæ; parascutella glabrous, paler yellow. Femora obscure yellow, tips narrowly (1 to 1.5 millimeters) blackened. Wings with a dark spot at origin of Rs and a broad seam along vein 2d A.

A few additional generic and specific characters may be noted. The antennæ of the female sex (Plate 2, fig. 25) on each flagellar segment beyond the first have three setæ on outer face at and beyond midlength; lower or larger ventral lobe with one very long verticil that exceeds in length the entire segment, as well as two shorter, unequal bristles, the longer of which becomes progressively longer on the outer segments; outer or smaller lobe of flagellum without major setæ; terminal segment prolonged at tip. Tibial spur formula 1–2–2; claws (female) simple. Venation (Plate 1, fig. 1): No vestige of Sc_1; Rs long; R_1 beyond free tip of Sc_2 about equal in length to latter; m-cu on M_4 some distance beyond origin of latter; cell 2d A wide. All outer radial veins with macrotrichia; veins M_1, M_2, and M_3 with fewer trichia; M_4 and Cu_1 with these setæ less numerous and scattered.

PRIONOTA NIGRICEPS van der Wulp.

Prionota nigriceps VAN DER WULP, Notes Leyden Mus. 7 (1885) 2, 3.
Prionota nigriceps ALEXANDER, Proc. U. S. Nat. Mus. 49 (1915) 181, 182, pl. 45, fig. 34 (wing); pl. 47, fig. 50 (antenna), figs. 51, 52 (hypopygial details).

Three males, Selabintanah, Mount Gedeh, western Java, altitude 3,000 feet, September, 1935 (*Walsh*). One male, Goenoeng Malang, Djampangs, western Java, altitude 4,000 feet, October, 1936 (*Walsh*).

In these specimens the following differences from van der Wulp's characterization are noted. Antennal scape black, pedicel reddish to brownish black. Petiole of cell M_1 very variable in length, in cases exceeding m, in others the cell narrowly sessile.

PSELLIOPHORA KANGEANENSIS sp. nov. Plate 1, fig. 2.

Head and thorax orange; halteres black; legs black, all tibiæ with a conspicuous subbasal white ring; wings uniformly suffused with black; abdomen with basal three segments orange, remainder, including hypopygium and ovipositor, black.

Male.—Length, about 13 to 15 millimeters; wing, 12 to 14; antenna, 4.5 to 5.

Female.—Length, about 20 to 22 millimeters; wing, 15 to 16.

Frontal prolongation of head orange-yellow, nasus a little darker; palpi with basal two segments dusky, outer segments

more yellowish. Antennæ with scape and pedicel reddish brown; flagellum black, incisures of the more basal segments restrictedly pale. Head orange, posterior orbits more yellowish.

Pronotum and mesonotum almost uniformly reddish orange, præscutum subopaque, without clearly defined darker areas; scutum orange, each lobe with two slightly darker areas. Pleura orange, dorsopleural membrane a little more yellowish orange. Halteres black, base of stem narrowly reddish. Legs with coxæ and trochanters orange; femora black, bases restrictedly yellow, narrowest on posterior legs; tibiæ black, all with a narrow but clearly defined and conspicuous white subbasal ring, vestiture of the annulus snowy white; tarsi black. Wings (Plate 1, fig. 2) uniformly suffused with black, stigma and costal portion a little more intense; in the female, cells R and M with pale linear central streaks beyond midlength; veins black. Squama naked, margin immediately beyond it with long dense black setæ. Venation: Cell M_1 narrowly to broadly sessile.

Abdomen with basal three segments orange; remainder of abdomen, excepting posterior border of fourth sternite, black.

Habitat.—Kangean Island (northeast of Java).

Holotype, male, Petapau, March 1936 (*Walsh*). Allotopotype, female, pinned with type. Paratopotypes, 10 males and females; paratypes, 2 males, 1 female, Ardjasa, March 1936 (*Walsh*).

The nearest relative of the present fly is *Pselliophora luctuosa* de Meijere, of western Java, which differs conspicuously in the coloration of the abdomen and in the structure of the male hypopygium.

PSELLIOPHORA LUCTUOSA de Meijere.

Pselliophora luctuosa DE MEIJERE, Tijd. voor Ent. 59 (1916) 199.

One male, Goenoeng Besser, Djampangs, western Java, May, 1936 (*Walsh*).

PSELLIOPHORA STIGMATICA FLAVOSCUTELLARIS subsp. nov.

Female.—Length, about 16 millimeters; wing, 14.

Differs from typical *stigmatica* de Meijere (Central Nias), as follows: Median præscutal stripe divided by a pale vitta, especially conspicuous on posterior half; dark areas on scutal lobes not confluent across midline; scutellum uniformly yellow, including parascutella; mediotergite not or scarcely darkened on posterior half. Blackened areas on both the anepisternum and ventral sternopleurite. Femora with only the distal fourth or less dark brown; tibiæ brown, white basal rings of the posterior pair much more extensive than those of other legs; tarsi black.

Wings with prearcular field weakly darkened; stigma pale yellow, its proximal end weakly darkened. Venation: Cell M_1 very short-petiolate. Basal abdominal tergites brownish black, their posterior margins yellow; sternites yellow, not or scarcely darkened.

Habitat.—Sumatra (Benkoelen).

Holotype, female, Tanjong Sakti, altitude 1,650 to 2,000 feet, June 11 to 20, 1935 (*Walsh*).

It seems probable that *Pselliophora chaseni* Edwards (Anamba Island, South China Sea) will likewise be found to represent a subspecific group of *stigmatica*. It differs from the present fly by the entire median præscutal stripe, posteriorly darkened mediotergite, and the distinctively patterned legs and wings.

PSELLIOPHORA BIAURANTIA sp. nov. Plate 1, fig. 3.

General coloration black; abdominal segments two and three orange; all tibiæ with a clearly defined white subbasal ring; wings black, variegated by five creamy-yellow areas, including a broken crossband of three areas before cord; cell M_1 sessile.

Female.—Length, about 17 millimeters; wing, 14.

Frontal prolongation of head and nasus black, dorsal surface of former with abundant black setæ; palpi brownish black. Antennæ black, 12-segmented (female); outer flagellar segments depressed, broader than long. Head velvety black.

Mesothorax uniformly black, three præscutal stripes glabrous and faintly nitidous, not otherwise differentiated from remainder of notum. Halteres black. Legs black, all tibiæ with a subbasal white ring, narrow but clearly defined on all legs; posterior femora stout, with inconspicuous setæ, extreme femoral bases pale. Wings (Plate 1, fig. 3) black, variegated by five creamy-yellow areas, including a major series of three forming an incomplete crossband before cord, located in cells R_1 and R, outer end of cell M, and outer end of cell Cu, respectively, interrupted by dark seams along veins M and Cu; the two additional creamy areas lie in the base and outer portion of cell 1st A; additional to these primary areas are pale longitudinal streaks in centers of cells R, M, M_3, M_4, Cu, and 1st A, these latter presumably a character of the female sex only, as common in the genus; cell 2d A more grayish, its base darker; veins dark brown. A fringe of long setæ on wing margin beyond squama. Venation: R_2 unusually long, erect; cell M_1 sessile.

Abdomen velvety black, with the single exception of segments two and three which are deep orange, lateral borders of tergites slightly darkened, caudal margin of third sternite narrowly brownish black; genital shield and ovipositor polished black; cerci straight, tips narrowly pale.

Habitat.—China (Kwangtung).

Holotype, female, Pi Shan, Yuen Hing Ying, low on mountain, among trees, May 26, 1936 (*Hai Tsz*).

Pselliophora biaurantia is most nearly allied to *P. speciosa* Edwards (Assam) and *P. stabilis* Alexander (Yunnan). These species are all smaller than *P. ctenophorina* Riedel (Formosa) but agree in the uniformly black head and thorax. The present fly differs from *speciosa* in the reduction of the orange on the abdomen and in the conspicuously patterned wings; from *stabilis* it is readily told by the coloration of the legs and abdomen, the increased number of antennal segments, and especially by the pattern of the wings.

PSELLIOPHORA UPSILON sp. nov. Plate 1, fig. 4.

Mesonotal præscutum and pleura yellow, variegated with black, cephalic half of præscutum black, posterior half covered by a U-shaped yellow area before the suture; scutellum yellow; knobs of halteres dark brown; femora black, bases yellow, the amount of the latter greatest on posterior legs; all tibiæ with a narrow, clearly defined, white subbasal ring; wings almost uniformly tinged with brown, stigma darker brown; cell M_1 short-petiolate; abdomen with basal four segments yellow, segments five to eight black; ninth segment (male) chiefly orange-red, blackened at apex.

Male.—Length, 13 to 14 millimeters; wing, 12 to 13; antenna, about 7.

Frontal prolongation of head above light sulphur-yellow, including nasus, infuscated laterally and beneath; palpi pale, distal end of terminal segment more darkened. Antennæ with scape and pedicel obscure yellow; flagellum and branches black, apices of the more basal segments narrowly brightened. Head orange, occiput and postgenæ brownish black.

Pronotum yellow medially, blackened on sides. Mesonotal præscutum with cephalic half, including humeral region, solidly black, the area produced more caudad along the midline, ending at near midlength of sclerite; opposite humeral region the dark

color becoming confluent with the black of prothorax; posterior half of præscutum uniformly orange, forming a U-shaped transverse saddle before suture; scutal lobes and suture blackened, median area of scutum and posterior portion of lobes yellow; scutellum testaceous yellow; mediotergite with posterior half and lateral borders black, anterior central portion orange-yellow. Pleura variegated orange-yellow and black, black color including propleura; a large but narrow area on mesosternum, this narrowed to virtually interrupted on dorsal sternopleurite, directly connected with dark color of scutal lobes; posterior half of pleurotergite and entire metapleural region black; dorsopleural region light yellow, excepting darkened end portions as described. Halteres yellow, extreme base of stem and the knobs dark brown. Legs with fore and middle coxæ yellow, hind coxæ blackened, their apical portions yellow; trochanters yellow, darkened apically; femora black, bases yellow, including about proximal third of fore femora, proximal half of midfemora, and proximal two-thirds of hind pair; tibiæ black, all with a clear-cut, narrow, white ring, slightly broader and somewhat more yellowish on posterior tibiæ; tarsi black. Wings (Plate 1, fig. 4) almost uniformly tinged with brown, the prearcular region and small stigma darker brown; veins brownish black. Venation: Cell M_1 petiolate, stem shorter than m.

Abdomen with basal four segments uniformly light yellow to orange-yellow; segments five to eight, inclusive, black; segment nine cylindrical, orange-red, apex including styli blackened.

Habitat.—Eastern Java.

Holotype, male, Baoeng Falls, Tengger Mountains, altitude 1,200 feet, February, 1936 (*Walsh*). Paratopotypes, 2 males.

By various keys to the species of *Pselliophora* the present fly runs to *P. fuscipennis* (Macquart), which differs notably in the coloration of the body and wings. The transverse yellow saddle of the present fly, involving the entire posterior half of the præscutum, is very conspicuous, and the pattern of the abdomen is similarly distinctive.

LONGURIO (LONGURIO) FULVUS Edwards.

Longurio fulvus EDWARDS, Ann. & Mag. Nat. Hist. 8 (1916) 262.

The types, females, were from northern China. I have before me a few specimens representing both sexes. In this material the orange color of the body is very bright and intense, more so than in material from Kiangsi Province and from Formosa. The present specimens were taken in Kwangtung

Province, southeastern China, by Mr. Hai Tsz, native collector for Mr. Tinkham.

Sui Hit Chi, Gow Bo Shan, Yue Hing Ying, on mountain grass, altitude over 1,000 feet, May 31, 1936. Ping Shan, Yue Hing Ying, June 5, 1936. Gee To Wa, June 7, 1936.

TIPULA (TIPULODINA) AMABILIS sp. nov. Plate 1, fig. 5.

Belongs to the *venusta* group; allied to *gracillima;* mesonotal præscutum with stripes confluent, scarcely differentiated from ground color; an incomplete, dark brown, transverse girdle extending from lateral ends of præscutal stripes across dorsopleural membrane onto dorsal sternopleurite; Rs short, transverse; R_{1+2} atrophied; R_3 long, deflected strongly toward wing tip.

Female.—Length, about 23 millimeters; wing, 15.5.

Frontal prolongation of head whitish above, blackened on sides and beneath; nasus elongate, white; basal segments of palpi dark brown, two distal segments paler, outer one darkened at apex. Antennæ with scape pale at base, darkened apically; pedicel dark brown; flagellum black, segments cylindrical, with verticils shorter than segments; terminal segment about two-thirds length of penultimate. Front and anterior vertex whitish; posterior vertex and occiput infuscated, with a capillary black median vitta extending from anterior vertex almost to occiput.

Pronotum dark brown medially, abruptly whitened on sides. Mesonotal præscutum almost covered by dark brown, the usual interspaces virtually concolorous with the stripes, the latter delimited by a slightly darker median vitta and by vague margins to the lateral stripes; a dark area opposite anterior end of lateral stripe, crossing the dorsopleural membrane and extending as a narrow incomplete girdle across the anepisternum onto sternopleurite; humeral triangle of præscutum abruptly light yellow; sides of præscutum before suture a little brightened; scutum dark brown; scutellum a little paler, parascutella dark; mediotergite pale brown, the posterior border and a central stem darker to form an inverted T-shaped area. Pleura pale yellow, variegated with brown, as described above; pleurotergite weakly infumed except at summit of tubercle. Halteres long and slender, black, base of stem restrictedly pale. Legs with coxæ whitened; trochanters white, with a dark spot on inner face at apex; fore and midle femora black, more yellowish basally, darker outwardly, with a narrow (1.3 millimeters) white ring immediately before the very narrow blackened apex; hind fe-

mora brown, tips deepening to black; fore and middle tibiæ black, with a relatively broad (2 millimeters) white ring at tip; hind tibiæ black, with a moderately broad (3 millimeters) white ring beyond base and another wider (4 millimeters) annulus at tip; fore and middle basitarsi black, tips narrowly (about the distal sixth or less) snowy white; posterior basitarsi black with about the outer three-fifths abruptly white; remaining tarsal segments white. Wings (Plate 1, fig. 5) subhyaline, with a very delicate yellowish tinge; stigma and a confluent seam on anterior cord brownish black; wing tip, in cells Sc_2 to R_5, inclusive, darkened, the area barely involving the cephalic margin of cell M_1; in cells R_3 and R_5 centers of darkened portions a little paler; cell Sc black; veins black, very distinct. Venation: R_{1+2} atrophied, so cells Sc_2 and R_2 are confluent; Rs very short, subequal to r-m and nearly in transverse alignment with the other elements of anterior cord; vein R_3 long, deflected strongly toward wing apex; cell 2d A moderately wide.

Abdominal tergites brown, variegated with more yellowish areas on basal rings before apices of segments; sternites more uniformly brownish yellow.

Habitat.—Western Java.

Holotype, female, Goenoeng Malang, Djampangs, altitude 4,000 feet, October, 1936 (*Walsh*).

Tipula (*Tipulodina*) *amabilis* is most closely allied to *T.* (*T.*) *gracillima* Brunetti, of southern India and Ceylon, differing in the coloration of the body and legs, and in the details of venation. In the present fly vein R_3 is shorter and more distant from the costal border than in *gracillima*. Both species have vein R_{1+2} atrophied, either wholly or except for a rudimentary basal spur.

TIPULA (VESTIPLEX) NOKONIS Alexander.

Tipula nokonis ALEXANDER, Philip. Journ. Sci. 36 (1928) 459–461.

The type, a male, was from Noko, Formosa, altitude 9,800 feet, collected June 27, 1927, by Issiki. A female specimen that surely seems to be conspecific is now available.

Female.—Length, about 22 millimeters; wing, 18.

Characters as in male, with the following differences: Palpi black. Antennæ with scape brownish black, pedicel light yellow; flagellum entirely black. Vertex of head chiefly dark brown, front more grayish; vertical tubercle low and entire. Ground color of mesonotum clearer gray than greenish gray. Femora obscure yellow, tips blackened, without a clearly-defined subterminal yellow ring. Ovipositor with cerci strongly com-

pressed, margins entirely smooth; hypovalvæ relatively short, not exceeding caudal end of genital shield.

Allotype, female, Kwanzan, Formosa, altitude 9,000 feet, June 30, 1936 (*R. Takahashi*).

TIPULA (VESTIPLEX) TAKAHASHIANA sp. nov. Plate 1, fig. 6.

Size small (wing, female, 9 millimeters); general coloration of thorax dark brown, præscutum with four narrow black stripes; antennal scape and pedicel light yellow, flagellum black, halteres dark brown, base of stem narrowly obscure yellow; femora black, with a narrow yellow subterminal ring; wings brown, vaguely brightened by more yellowish areas; Rs about twice length of m-cu; cerci yellow, margins entire.

Female.—Length, about 12.5 millimeters; wing, 9.

Frontal prolongation of head yellow above, blackened on sides and beneath; nasus distinct; palpi black. Antennæ with the scape and pedicel light yellow, flagellum black; flagellum with some of the segments fused, including the basal two and the apical pair; segments short-cylindrical, simple, with verticils that exceed the segments in length. Front and anterior vertex golden-yellow, with a narrow capillary dark vitta extending from summit of the simple vertical tubercle to occiput; sides of posterior vertex and genæ infuscated.

Pronotum brownish black. Mesonotal præscutum dark brown, with four narrow black stripes, intermediate pair connected in front, convergent behind, apparently representing darkened borders of a median stripe; long yellow setæ on præscutal interspaces; posterior sclerites of notum brown. Pleural, including dorsopleural membrane, dark brown. Halteres dark brown, base of stem narrowly obscure yellow. Legs with coxæ dark brown; trochanters yellow; femora black, base of fore femora narrowly yellow; all femora with a narrow but conspicuous subterminal yellow ring placed a little more than its own length from tip; tibiæ testaceous-brown, tips narrowly darkened; tarsi black. Wings (Plate 1, fig. 6) relatively small and narrow, but not showing indications of degeneration of venation; ground color brown, vaguely brightened by more yellow areas, including the prearcular field; a common mark near bases of cells M to 2d A, inclusive; small spots before and beyond origin of Rs; a poststigmal brightening in cells R_2 and R_3; conspicuous, more whitish, obliterative areas before stigma and across base of cell 1st M_2; veins brown. Venation: Rs relatively long, about twice m-cu; cell 1st M_2 relatively large, its inner end pointed; petiole of cell M_1 shorter than m; cell 2d A narrow.

Abdomen reddish brown, the tergites more blackened medially; subterminal segments more uniformly blackened. Cerci yellow, with entire margins; hypovalvæ very reduced, black.

Habitat.—Formosa.

Holotype, female, Hattsukan, altitude 9,000 feet, August 23, 1936 (*Takahashi*).

I take unusual pleasure in naming this interesting *Tipula* in honor of the collector, my long-time friend, Professor Ryoichi Takahashi, to whom I express my deep indebtedness for many favors in connection with a study of the Tipulidæ of the Japanese Empire. The species is very distinct from the other regional species of the genus in size, in the coloration of the body, wings, and legs, and in the entire cerci. *Tipula* (*Vestiplex*) *deserrata* Alexander, of western China, and *T.* (*V.*) *nokonis* Alexander, of Formosa, have similar entire cerci, but in all other regards are quite distinct flies. The condition of having the cerci untoothed appears to be more common in *Vestiplex* than had hitherto been believed.

TIPULA (VESTIPLEX) BICORNIGERA sp. nov. Plate 2, figs. 26 and 27.

Allied to *bicornuta;* general coloration yellow, præscutum with four brown, unmargined stripes; antennæ (male) relatively elongate, flagellum black; knobs of halteres dark brown; femora obscure brownish yellow, tips narrowly black, preceded by a clearer yellow ring; wings pale brown, variegated by slightly darker brown and cream-colored areas; male hypopygium with tergite produced into a median plate that divides into two yellow divergent lobes that are set with strong black setæ; basistyle produced into a nearly straight black spine; inner dististyle a compressed high blade.

Male.—Length, about 11 millimeters; wing, 12.5; antenna, about 5.

Frontal prolongation of head light yellow, slightly darker on sides; nasus slender; palpi brownish black. Antennæ (male) relatively elongate, as shown by the measurements; scape and pedicel light yellow; first flagellar segment brown, narrowed outwardly; remainder of flagellum black; flagellar segments with moderately large basal enlargements; verticils long but still somewhat shorter than segments; terminal segment about one-fourth length of penultimate. Head yellow, with a narrow brown median vitta; vertical tubercle small and low.

Pronotum dark medially, golden-yellow pollinose. Mesonotal præscutum with ground color golden pollinose, with four brown

stripes, intermediate pair entirely confluent at extreme cephalic portion, narrowly separated on posterior two-thirds; posterior interspaces with small dark triangles just before suture; setæ of interspaces small, yellow; scutum yellow, each lobe with two brown areas, median region with a capillary dark vitta that continues almost unbroken over central area of scutellum and mediotergite. Pleura yellow. Halteres with stem obscure yellow, knob dark brown. Legs with coxæ and trochanters yellow; femora obscure brownish yellow, tips rather narrowly (about 1 millimeter) black, extreme tip a trifle paler, black areas subequal in length on all legs; black femoral apices preceded by a clearer yellow subterminal ring of approximately equal length; tibiæ and tarsi black. Wings pale brown, variegated by slightly darker brown and cream-yellow areas; prearcular region and cell C uniformly yellow, cell Sc a trifle more infuscated on basal half; dark areas including stigma and a confluent seam on anterior cord and another area at origin of Rs; cream markings involving cells before cord, as well as a narrow, incomplete, poststigmal area from C into cell R_5, nearly reaching obliterative mark across cell 1st M_2; outer radial and medial cells almost uniformly pale brown, not or scarcely variegated; veins brown, a little paler in the more yellowish areas. Venation: Rs a little more than twice m-cu; R_3 nearly straight, not markedly upcurved on distal portion (as in *biserra*), cell R_2 at margin thus much more extensive than cell R_3; petiole of cell M_1 a little longer than m; cell 1st M_2 pentagonal in outline, its outer end only moderately pointed; m-cu shortly before fork of M_{3+4}.

Abdominal tergites yellow, trivittate with darker, including a more clearly defined, nearly continuous, median stripe and paler brown submarginal stripes, extreme borders pruinose; outer segments uniformly darkened; basal sternites yellow. Male hypopygium somewhat as in *bicornuta* but with the details very different. Ninth tergite (Plate 2, fig. 26, 9*t*) with the median area produced caudad into a flattened yellow plate that forks into two divergent lobes set with short blackened setæ that are directed outward; dorsal lateral angles of tergite produced into small black lobes that are tipped with a few setæ; posterior or cephalic portions of tergal saucer blackened and microscopically roughened, saucer divided at midwidth by pale membrane. Basistyle (Plate 2, fig. 27, *b*) bearing a powerful black spine, nearly straight, tip obtuse. Outer dististyle a dusky, flattened-clavate lobe. Inner dististyle (Plate 2, fig. 27,

id) much deeper than in *bicornuta*, stem portion near base bearing a conspicuous black spine. Eighth sternite simple, unmodified by lobes, and with very few setæ.

Habitat.—Formosa.

Holotype, male, Oiwake, Noko-gun, altitude 7,570 feet, August 12, 1936 (*Takahashi*).

The nearest ally of the present fly is undoubtedly *Tipula* (*Vestiplex*) *bicornuta* Alexander, likewise from the high mountains of Formosa. The latter species is a trifle larger, with bicolorous antennal flagellum, shorter Rs, and a very differently constructed male hypopygium, the distinctions in the latter, including the tergite, the spine of the basistyle, and especially the inner dististyle which is narrow and drawn out into a long apical beak.

TIPULA (OREOMYZA) NIITAKENSIS sp. nov. Plate 1, fig. 7; Plate 2, figs. 28 to 30.

General coloration of mesonotum olive-gray, præscutum with four darker stripes; antennal flagellum uniformly black; femora obscure yellow, tips narrowly blackened; wings pale brown, variegated with numerous, small, cream-colored areas distributed over surface; cell M_1 narrowly sessile; abdominal tergites trivittate with brownish black, median stripe entire; outer abdominal segments uniformly darkened; male hypopygium with tergite deeply emarginate, lateral lobes slender, pale, provided with setæ to their tips; eighth sternite unmodified.

Male.—Length, about 14 millimeters; wing, 16; antenna, about 4.2.

Frontal prolongation of head grayish brown; nasus slender; palpi brownish black. Antennæ with scape and pedicel yellow; flagellum black; flagellar segments weakly incised; longest verticils subequal in length to segments; terminal segment nearly one-third length of penultimate. Head brownish gray, front and vertical tubercle light yellow; a capillary median vitta from summit of vertical tubercle backward, becoming nearly obsolete on posterior vertex.

Pronotum olive-brown, darker in front. Mesonotal præscutum olive-gray, with four darker stripes, intermediate pair darker brown, separated by a very indistinct gray median vitta, their margins narrowly and insensibly bordered by darker; lateral stripes more grayish brown, mesal edge darker; scutum olive-gray, each lobe with two confluent brown areas; median area of suture and posterior sclerites of mesonotum olive-gray, with a nearly continuous brown median vitta. Pleura chiefly

olive-gray, yellowish sericeous. Halteres with stem brownish yellow, knob dark brown with paler apex. Legs with coxæ olive-yellow; trochanters yellow; femora obscure yellow, tips rather narrowly (2 millimeters) blackened, the amount subequal on all legs, this tip preceded by a vague, clearer yellow, subterminal ring; tibiæ brownish yellow, tips narrowly brownish black; tarsi brownish black. Wings (Plate 1, fig. 7) with ground color pale brown, variegated by numerous small cream-colored areas, distributed over surface, larger in basal cells; pale areas before and beyond origin of Rs; an incomplete post-stigmal yellow band in cells Sc_2 to R_5, inclusive; a conspicuous, more whitish spot in cell 1st M_2 and the adjoining portion of cells M_3 and M_4; outer medial cells uniformly darkened; cell 2d A pale at both ends; cells C and Sc uniformly yellow; veins brown, a little paler in the brightened areas. Venation: R_{1+2} entire; cell M_1 narrowly sessile or microscopically petiolate; cell 2d A of moderate width.

Abdomen yellow, tergites trivittate with brownish black; median stripe entire, on sixth to ninth segments involving entire sclerites; lateral stripes paler, margins of segments narrowly gray; sternites yellow, terminal segments blackened. Male hypopygium (Plate 2, fig. 28) of moderate size; tergite, *9t*, only indistinctly separated from sternite by pale membrane; basistyle entirely distinct. Ninth tergite (Plate 2, fig. 29, *9t*) with a very deep V-shaped notch, so the sclerite at midlength is very narrow; lateral angles produced into slender pale lobes, clothed with setæ to their tips; on ventral surface on either side a blackened expanded lobe, its apical margin microscopically serrulate. Outer dististyle (Plate 2, fig. 30, *od*) elongate, distal half expanded into a narrow blade. Inner dististyle (Plate 2, fig. 30, *id*) with the apical beak slender, simple, blackened; from its base a long flattened ribbonlike blade, apex obtuse, provided with a few long setæ. Eighth sternite (Plate 2, fig. 28, *8s*) not produced, its margin pale and unmodified by lobes or setæ; near base, on either side of midline, with a transverse linear pale line.

Habitat.—Formosa.

Holotype, male, Mount Niitaka, August 25, 1936 (*Takahashi*).

Tipula (*Oreomyza*) *niitakensis* is quite distinct from other regional species of the subgenus in the sessile cell M_1 and in the structure of the male hypopygium, especially the ninth tergite and styli. This is another species that may well be better

placed in the subgenus *Vestiplex* Bezzi. A list of the critical species that may with almost equal propriety be placed in *Oreomyza* or *Vestiplex* has been provided in another paper of this series.[2]

TIPULA (OREOMYZA) TRIDENTATA Alexander.

Tipula tridentata ALEXANDER, Ann. Ent. Soc. America **13** (1920) 265, 266.

Tipula (*Oreomyza*) *tridentata* ALEXANDER, Philip. Journ. Sci. **57** (1935) 123.

The type locality was Musha, Formosa, altitude about 3,700 feet, May 18 to June 15, 1919. Additional Formosan records are: Arisan, altitude 8,000 feet, August 26, 1936 (*Takahashi*). Mount Gokwan, altitude 10,000 feet, August 12, 1936 (*Takahashi*).

In this species there is considerable variation in the coloration of the antennal scape and in the relative width of the yellow subterminal femoral rings.

NEPHROTOMA NIGROCENTRALIS sp. nov. Plate 2, figs. 31 and 32.

General coloration sulphur-yellow and black; antennæ (male) relatively long, flagellum black; orbits with dark spots; præscutum with three polished black stripes that are narrowly bordered by velvety black; lateral stripes straight, crossing suture onto scutal lobes; scutellum black; mediotergite clear yellow, its posterior fourth blackened; knobs of halteres sulphur yellow; fore femora pale at both ends, with nearly the central half black; wings whitish subhyaline, stigma, cells Sc and Cu_1, and a seam along vein Cu in cell M dark; no stigmal trichia; subterminal abdominal segments blackened; hypopygium orange; male hypopygium with the lateral tergal lobes broad; eighth sternite without modified setæ.

Male.—Length, about 12 millimeters; wing, 10; antenna, about 5.

Frontal prolongation of head yellow, blackened laterally and beneath and with a narrow black dorsal area that includes the nasus; palpi brownish black. Antennæ (male) relatively long, as shown by measurements; scape and pedicel obscure yellow, flagellum black; flagellar segments strongly incised; longest verticils much shorter than segments. Head orange; posterior orbits with a large velvety black area on either side, directly behind antennal bases; occipital brand triangular, its anterior point acute but not reaching base of vertical tubercle.

[2] Philip. Journ. Sci. 57 (1935) 118.

Pronotum broadly yellow medially, blackened on sides. Mesonotal præscutum light yellow, with three polished black stripes that are very narrowly bordered by more velvety black, posterior interspaces reduced to narrow lines; lateral stripes nearly straight, velvety border at their anterior end a trifle expanded but scarcely outcurved; scutum yellow, centers of lobes black, connected across suture with lateral præscutal stripes, and further confluent behind with polished black scutellum; parascutella weakly infumed; mediotergite clear sulphur-yellow, posterior fourth blackened, with sparse pale setæ only. Pleura sulphur-yellow, including dorsopleural membrane, variegated with black on anepisternum, dorsal pteropleurite and posterior pleurotergite; ventral sternopleurite and meron more reddish. Halteres with stem black, knob light sulphur-yellow. Legs with coxæ obscure yellow, fore and hind coxæ narrowly blackened at bases; trochanters yellow; fore femora with base and apex yellow (about 2 millimeters), leaving central portion more broadly (about 3.5 millimeters) black; remaining femora obscure yellow, tips very narrowly blackened; tibiæ yellowish brown, tips narrowly blackened; tarsi black. Wings whitish subhyaline; stigma and cell Sc blackened; a dusky seam in cell M adjoining vein Cu; cell Cu_1 darkened; veins black. Stigma without trichia, except that in one wing of type there is a single one on the extreme border of proximal end, the character undoubtedly being variable. Venation: Sc_1 persistent as a spur; Sc_2 opposite origin of Rs, latter in oblique alignment with basal section of R_{4+5}; cell 1st M_2 small; cell M_1 narrowly sessile; m-cu on M_4 just beyond origin, latter a corresponding distance from fork of M_3.

Abdomen black, segments two to five, inclusive, with bases broadly yellow, the amount of the latter including more than basal half of segment, less extensive on segment five; subterminal segments black; hypopygium orange. Male hypopygium with caudal margin of tergite (Plate 2, fig. 31, *9t*) bearing a very deep and narrow median incision, adjoining lobes with abundant black spinous points; lateral angles of tergite produced into broader and more truncated lobes that bear an apical group of similar spines, lateral and intermediate lobes separated by a U-shaped notch above and an obtuse sclerotized flange below. Outer dististyle (Plate 2, fig. 32, *od*) relatively broad, produced apically into a cylindrical lobe. Inner dististyle (Plate 2, fig. 32, *id*) simple, apical beak slender. Median region of ninth sternite produced ventrad into a small conical pale point. Eighth

sternite extensive, caudal portion with a U-shaped median incision filled with pale membrane, lateral apical portions paling to yellow and without setæ. Gonapophyses small and pale, apical blade in slide mounts appearing twisted and crumpled.

Habitat.—Sumatra (Benkoelen).

Holotype, male, Moeara Tenam, June 16 to 23, 1935 (Walsh).

The most similar described species is *Nephrotoma medipubera* Edwards, of eastern Java, which has the fore femora somewhat similarly patterned, but differs in other details of coloration of the body, in the details of venation, and in the presence of dense setæ on the postnotal mediotergite.

NEPHROTOMA PALLIDAPEX sp. nov. Plate 1, fig. 8; Plate 2, figs. 33 and 34.

General coloration yellow, with black markings; frontal prolongation of head black; antennal flagellum black; no differentiated occipital brand; præscutal stripes polished black, narrowly bordered by more velvety black; scutellum yellow; knobs of halteres clear yellow; legs black, femoral bases obscure yellow; wings with cells basad of cord weakly tinted with brown, those beyond cord clear gray; stigma oval, brown; cell Sc darkened; outer abdominal segments, including hypopygium, black.

Male.—Length, about 12 millimeters; wing, 10.5; antenna, about 3.5.

Frontal prolongation of head, including nasus, entirely black; palpi black. Antennæ relatively short, as shown by the measurements; scape and pedicel obscure yellowish brown, flagellum black; flagellar segments strongly incised; longest verticils a little shorter than segments. Front and anterior vertex sulphur-yellow, posterior vertex more orange; a small darker orange-brown spot near posterior orbits, behind antennal bases, not touching the eye margin; posterior genæ conspicuously brownish black, more pruinose on ventral portions; no differentiated occipital brand.

Pronotum yellow medially, blackened on sides. Mesonotal præscutum sulphur-yellow, with three polished black stripes that are narrowly bordered by more velvety black; posterior interspaces relatively wide; lateral stripes straight but with a faint darker cloud opposite their anterior ends; scutum yellow, lobes chiefly covered by confluent polished black areas that are narrowly bordered by velvety black, very narrowly separated at suture from lateral præscutal stripes; scutellum yellow, parascutella infuscated on central portion; mediotergite yellow, broad, central portion of posterior third darkened; a few long coarse

black setæ at posterolateral portions of mediotergite. Pleura yellow, variegated by black on propleura; anepisternum, this including a narrow border adjoining the pteropleurite in addition to major darkened portion lying more cephalad; ventral sternopleurite and meron; dorsal and posterior portions of pleurotergite. Halteres obscure yellow, knobs clear sulphur-yellow. Legs with coxæ black, with abundant long white setæ; trochanters brown; femora black, basal third or less obscure yellow; tibiæ and tarsi black. Wings (Plate 1, fig. 8) with cells basad of cord weakly tinted with brown, those beyond cord abruptly clear gray; stigma oval, brown, cell Sc uniformly darkened; veins dark brown. Stigmal trichia about five. Venation: Sc_1 present; Sc_2 extending to just beyond origin of Rs, the latter longer than basal section of R_{4+5}; cell M_1 narrowly sessile; veins M_3 and M_4 arising at fork of M, m-cu just beyond origin of latter.

First abdominal tergite velvety black; tergites two to four, inclusive, obscure yellow, posterior margins with low black triangles, the points directed forward; basal sternites uniformly pale; segments five to nine, including hypopygium, black. Male hypopygium of unique type, with tergite accidentally lost in dissecting. Outer dististyle (Plate 2, fig. 33, *od*) moderately attenuated. Inner dististyle (Plate 2, fig. 34, *id*) with beak stout, disc of style set with coarse black retrorse setæ. Ninth sternite with a median pale lobe, directed ventrad, lying in notch of extensive, feebly emarginate eighth sternite.

Habitat.—Sumatra (Benkoelen).

Holotype, male, Boekit Jtam, altitude 1,000 to 2,000 feet, June 11 to 15, 1935 (*Walsh*).

Nephrotoma pallidapex is readily told from all allied regional species by the peculiar pattern of the wings. From other forms with the frontal prolongation of the head black and with undifferentiated occipital brand, as *N. nigrirostris* Edwards (Pahang), it differs evidently in the coloration of the body and wings.

DOLICHOPEZA (DOLICHOPEZA) KATOI sp. nov. Plate 1, fig. 9; Plate 2, fig. 35.

Mesonotal præscutum and scutum darkened; thoracic pleura uniformly pale yellow; femora yellow, tips narrowly blackened; all tarsi snowy white; wings with a strong brown tinge, stigma slightly darker; Rs short and transverse; medial forks of moderate depth; male hypopygium with caudal margin of tergite trilobed, median lobe obtuse.

Male.—Length, about 14 millimeters; wing, 13.5; antenna, about 5.5.

Frontal prolongation of head brownish black; palpi black. Antennæ with basal three segments pale yellow, remainder of flagellum black, incisures of more basal segments narrowly pale; flagellar segments long-cylindrical, without developed basal swellings; verticils shorter than segments. Head brownish black, silvery pruinose in front.

Pronotum brownish black, paler laterally. Mesonotal præscutum and scutum almost uniformly polished brownish black, the former paler laterally; scutellum and mediotergite more brownish testaceous. Pleura and pleurotergite uniformly pale yellow. Halteres elongate, stem obscure yellow, knob infuscated. Legs with coxæ and trochanters pale yellow; femora yellow, tips narrowly brownish black, the amount subequal on all legs; tibiæ obscure yellow, tips very narrowly darkened; tarsi snowy white. Wings (Plate 1, fig. 9) with a strong brown tinge, cell Sc more yellowish; stigma pale brown; indistinct pale brown seams on m-cu and distal section of Cu_1; obliterative areas before and beyond stigma and at r-m small but conspicuous; veins brownish black, paler in costal portion. Macrotrichia of veins abundant but relatively small and delicate. Venation: Sc_2 ending a short distance before transverse, entirely pale Rs; free tip of Sc_2 some distance before R_2, R_1 thus preserved, with about ten trichia; medial forks of moderate length; cell 2d A relatively wide.

Abdominal tergites almost uniformly brown, the outer segments and hypopygium more brownish black, lateral borders of segments obscure yellow; sternites yellow. Male hypopygium (Plate 2, fig. 35) with caudal margin of tergite, *9t*, trilobed, median lobe obtuse. Outer dististyle a small, elongate, pale lobe. Inner dististyle, *id*, powerful, oval in outline, margin of apical portion blackened. What appears to be a lobe from the sternite, *8s*, is long and slender, a little expanded and weakly bilobed at apex, entire surface with abundant pale setæ.

Habitat.—Japan (Honshiu).

Holotype, male, Yamagawa, Iwate, June 7, 1936 (*Kato*); collector's No. 15.

I take great pleasure in naming this fly in honor of the collector, Mr. Takeo Kato. The only other described species of the subgenus in eastern Asia is *Dolichopeza* (*Dolichopeza*) *issikiella* Alexander, of southern Formosa, an entirely different

fly. The present insect is one of the most distinct species of the genus so far discovered.

DOLICHOPEZA (NESOPEZA) THISBE sp. nov. Plate 1, fig. 10; Plate 2, fig. 36.

General coloration testaceous yellow, præscutum with three dark brown stripes, median area divided by a paler median vitta; antennal flagellum brown; wings whitish subhyaline, heavily patterned with brown, markings much broken and less extensive than ground color; R_{1+2} entirely atrophied; medial forks short.

Male.—Length, about 9 millimeters; wing, 9; antenna, about 3.5.

Frontal prolongation of head brownish black; palpi black, outer end of terminal segment paling to whitish. Antennæ relatively long, if bent backward extending about to base of abdomen; scape and pedicel pale; flagellum pale basally, passing into brown; flagellar segments cylindrical, with short abundant setæ and a single long verticil on each segment, placed beyond midlength, this bristle shorter than segment; terminal segment long-oval, a little more than one-third length of penultimate. Head dark; eyes large, reducing extent of vertex.

Pronotum dark brown, posterior margin paler. Mesonotal præscutum with ground color testaceous-yellow, with three brown stripes, median stripe divided for all but its anterior portion by a pale vitta; lateral stripes entire, their lateral portion produced to border of sclerite but a little paler than the stripe itself; scutum pale, lobes variegated by darker; scutellum chiefly darkened; mediotergite pale, somewhat darker medially. Pleura dark brown, variegated with paler yellowish brown on pteropleurite and pleurotergite. Halteres elongate, stem pale yellow, knob dark brown. Legs with fore coxæ dark brown, midcoxa slightly darkened at base, posterior coxæ pale; trochanters pale yellow; femora dirty white, tips rather narrowly (0.5 millimeter) dark brown, the amount about equal on all legs; tibiæ white, tips very narrowly but conspicuously black, middle and hind tibiæ faintly darkened on basal half, just beyond the narrow, pure white bases; tarsi white. Wings (Plate 1, fig. 10) whitish subhyaline, heavily patterned with brown, markings arranged much as in *titania* but more broken, ground color exceeding in area the brown pattern; in *titania* the ground color is grayish subhyaline, each dark area being narrowly bordered by whitish, whereas in the present fly there are no such pale margins to the brown markings; prearcular field uniformly darkened; veins

dark. Venation: Sc long, Sc_2 ending opposite fork of Rs, the latter long, spurred near origin; vein R_1 beyond free tip of Sc_2 bending into R_{2+3}, with no trace of vein R_{1+2}; medial forks shallow; m-cu less than its own length before fork of M.

Abdominal tergites brown, paler laterally; sternites more uniformly yellow, with vague transverse dark clouds or bands; hypopygium dark. Male hypopygium (Plate 2, fig. 36) small and of simple construction. Ninth tergite, *9t*, with the caudal margin blackened and sclerotized, median region a little produced into a low obtuse lobe; lateral portions of tergite more expanded, lateral ends with about six small blackened conical spines. Outer dististyle, *od*, small, long-oval, with about fifteen long setæ. Inner dististyle, *id*, with apex of apical beak truncated. Eighth sternite small, unmodified except medially where there is a small emargination in which the ædeagus lies in a position of rest.

Habitat.—Western Java.

Holotype, male, Goenoeng Tjimerang, Djampangs, altitude 2,100 feet, April, 1936 (*Walsh*).

The nearest relative of the present fly is *Dolichopeza* (*Nesopeza*) *titania* (Alexander) of Sumatra [3] which has the same general coloration of the body, wings, and legs, and with the venation very similar. The present fly differs especially in the more dissected dark wing pattern and the very different ground color, the brown markings not being bordered by whitish and thus producing a very different effect. The wings of *thisbe* are shorter and slightly wider than in *titania*, with the proportions of the cells correspondingly modified; vein R_3 is shorter and more arcuated, while Rs is distinctly short, being less than the distal section of R_{4+5}.

LIMONIINÆ

LIMONIINI

LIMONIA (LIMONIA) FUSCICEPS NIGRICUSPIS subsp. nov.

Male.—Length, about 8.5 millimeters; wing, 10.

Characters as in typical *fusciceps* Alexander (Hokkaido, Honshiu), differing especially in the details of the male hypopygium.

Male hypopygium with mesal apical lobe of gonapophysis stout, gently curved, heavily blackened. In the typical form these lobes are slender, weakly darkened, the tips acute or subacute, the concave margin with a low, erose flange.

Habitat.—Japan (Honshiu).

[3] Supplementa Entomol. 15 (1927) 92, 93, fig.

Holotype, male, Matsuo, Iwate, altitude 3,250 feet, May 31, 1936 (*Yamamoto*).

DICRANOPTYCHA STYGIPES sp. nov. Plate 1, fig. 11.

General coloration gray, præscutum with four scarcely indicated darker gray stripes; legs black, femoral bases yellow, narrowest on forelegs.

Female.—Length, about 12 millimeters; wing, 11.5.

Rostrum gray pruinose; palpi black. Antennæ with scape dark brown, pruinose; pedicel brownish yellow, flagellum black; flagellar segments oval to long-oval, ends truncated; verticils about one and one-half as long as segments. Head gray.

Thoracic dorsum gray, præscutum with four scarcely indicated darker gray stripes, anterior ends of intermediate pair obsolete. Pleura gray. Halteres pale yellow. Legs with coxæ pale, surface sparsely pruinose, most distinct on fore pair; trochanters obscure yellow; femora black, bases yellow, narrowest on forelegs where about the proximal sixth is involved, broader on middle and hind femora, on the latter including about the basal third; tibiæ and tarsi black. Wings (Plate 1, fig. 11) with a strong brownish yellow tinge, prearcular and costal regions clearer yellow; veins beyond cord brown, those basad of cord and in costal field more yellowish. Venation: Cell 1st M_2 about as lond as vein M_4 beyond it; m-cu at or shortly before midlength of cell.

Abdomen black, surface sparsely pruinose; genital shield black, cerci and hypovalvæ horn-yellow to yellowish brown, tips of cerci darker.

Habitat.—Japan (Honshiu).

Holotype, female, Matsuo, Iwate, altitude 2,600 feet, June 14, 1936 (*Yamamoto*). Paratopotype, female, altitude 3,250 feet, June 21, 1936.

Dicranoptycha stygipes is most closely allied to *D. yamata* Alexander, which has the legs differently colored, the tibiæ and basitarsi being light brown to yellowish brown with the tips narrowly infuscated. The latter species further differs in having the wings longer and narrower, with the inner end of cell 1st M_2 but little arcuated and with m-cu closer to the fork of M.

PROTOHELIUS TINKHAMI sp. nov. Plate 1, fig. 12; Plate 3, fig. 37.

General coloration ferruginous-yellow; antennæ (male) elongate, if bent backward extending about to base of abdomen;

legs yellow; wings relatively narrow, grayish yellow, clearer yellow in the prearcular and costal fields; stigma small, oval, pale brown; abdomen, including hypopygium, brownish yellow.

Male.—Length, 7 to 8 millimeters; wing, 7 to 8; antenna, 3 to 3.3.

Female.—Length, 9.5 to 10 millimeters; wing, 8 to 8.2.

Rostrum brownish yellow; basal two segments of palpus obscure yellow, outer segments black. Antennæ (male) relatively elongate, if bent backward extending about to base of abdomen; scape, pedicel, and basal three or four flagellar segments yellow, outer segments passing into brown; flagellar segments long-oval to subcylindrical, with a short dense pubescence; longest verticils about as long as segments. Head gray pruinose over a brown ground; eyes (male) large and protuberant; anterior vertex relatively wide, more than twice diameter of scape.

Thorax entirely ferruginous-yellow, unmarked, except that in some cases the præscutum is a trifle more brownish yellow. Halteres pale, knobs weakly darkened. Legs with coxæ and trochanters ferruginous-yellow; remainder of legs yellow, terminal tarsal segments darkened. Wings (Plate 1, fig. 12) relatively narrow, grayish yellow, prearcular and costal areas clear luteous; stigma small, oval, pale brown; veins brown, yellow in luteous areas. Venation: Sc_2 varying from just before to about opposite fork of Rs; distance on C between Sc_1, free tip of Sc_2, and R_{4+2} subequal; R_{2+3} and R_{4+5} subequal; inner end of cell 1st M_2 strongly arcuated; m-cu variable in position, from shortly before to just beyond fork of M.

Abdomen, including hypopygium, brownish yellow. Male hypopygium (Plate 3, fig. 37) with the two diststyles of generally similar form, as in the genus, the outer one, *od,* glabrous and blackened, the inner style, *id,* pale, with both lobes stouter and provided with erect setæ. Ovipositor with the valves long and slender.

Habitat.—China (Kwangtung, Kiangsi).

Holotype, male, Loh Fau Shan, near Wa Shan Tói Monastery, Kwangtung, altitude about 1,000 feet, April 27, 1936 (*Tinkham*). Allotopotype, female, pinned with type. Paratopotypes, 1 male, 2 females. Paratype, male, Hong San, southeastern Kiangsi, altitude 1,500 feet, July 16, 1936 (*Gressitt*).

Protohelius tinkhami is respectfully dedicated to the collector, Mr. Ernest R. Tinkham, to whom I express my thanks for cooperation in studying the Tipulidæ of eastern China. The only

other species so far made known is the genotype, *P. issikii* Alexander, of Formosa, which differs conspicuously in the much larger size, the blackened mesonotum, the broad grayish brown wings with a distinct stigmal area, and in other characters.

The exact affinities of *Protohelius* still remain in question. As indicated at the time of the original defining of the genus,[4] the group is of extreme importance in that it clearly indicates how the more reduced venation of the subtribe *Heliaria* has been brought about. Furthermore, the general structure of the male hypopygium and the venation of the medial field of the wing is strongly suggestive of the genus *Electrolabis* Alexander[5] of the Baltic Amber, a group that I am now inclined to consider identical with *Lipsothrix* Loew. In the latter case, vein R_{1+2} is elongate, whereas in the present fly it is short, curved abruptly into the margin, and thus in almost transverse alignment with vein R_2.

The known distribution of the genus, with one species in Formosa and another in southeastern China, is very interesting. Gressitt, in a significant paper on the zoögeographical relationships of Formosa,[6] indicates a type of distribution in the island where the species concerned must have found their way into Formosa through Siam and Indo-China, rather than by way of the Philippine Archipelago. The present instance would seem to fall within this category.

PEDICIINI

DICRANOTA (RHAPHIDOLABIS) CLAUSA sp. nov. Plate 1, fig. 13; Plate 3, fig. 38.

General coloration of head and thorax light gray, præscutum with three darker, brownish gray stripes; antennæ 17-segmented; femora yellow basally, tips broadly blackened, most extensively so on the fore pair; wings with a yellow tinge, more conspicuous in the prearcular and basal costal regions; stigma oval, dark brown; darkened seams on cord, outer end of cell 1st M_2, and along vein Cu; R_{2+3+4} a little shorter than basal section of R_5; cell 1st M_2 closed; cell M_1 subequal to its petiole; abdomen dark brown, basal sternites more obscure yellow; male hypopygium with the tergite extensive, gradually narrowed outwardly, apex with a shallow median notch.

Male.—Length, about 9 millimeters; wing, 9.8.

[4] Philip. Journ. Sci. 35 (1928) 466, 467.
[5] Bernstein-Forschungen (2) (1931) 58.
[6] Entomological World. Tokyo 4 (1936) 711–727.

Rostrum black, pruinose; palpi black. Antennæ 17-segmented, black, scape and pedicel more pruinose; flagellar segments oval; verticils shorter than segments. Head light gray.

Pronotum light gray. Mesonotal præscutum light gray, with three darker brownish gray stripes, the broad median stripe divided by a pale vitta on about its cephalic half; posterior sclerites of mesonotum gray, scutal lobes variegated with darker gray. Pleura clear ashy gray, dorsopleural membrane more dusky. Halteres yellow, knobs very slightly darker. Legs with coxæ pale, fore coxæ more darkened; trochanters yellow; femora yellow basally, tips broadly blackened, most widely so on fore pair where about the distal two-thirds is darkened, narrowest on posterior femora where about the outer fourth is blackened; tibiæ and tarsi brownish black to black. Wings (Plate 1, fig. 13) with ground color yellowish, prearcular field and basal costal region clear light yellow; stigma oval, dark brown; rather conspicuous dark seams on cord, outer end of cell 1st M_2, and along vein Cu; extreme wing tip a little darkened; veins brown, brightened in the flavous areas. Venation: Sc_1 ending nearly opposite the level of m; Rs relatively long, only feebly arcuated; R_{2+3+4} somewhat shorter than basal section of R_5; cell 1st M_2 closed; cell M_1 subequal to its petiole.

Abdomen, including hypopygium, dark brown; basal sternites more obscure yellow. Male hypopygium (Plate 3, fig. 38) with tergite, *9t*, extensive, gradually narrowed outwardly, apex with a shallow median notch; lateral lobes very low, obliquely truncated; lateral tergal arms produced into elongate yellow blades. Basistyles, *b*, relatively short and stout; interbase, *i*, a curved flattened blade, bearing a small, toothlike spine at the lower mesal angle. Outer dististyle, *od*, with relatively few spines. Inner dististyle, *id*, with a very extensive shoulder on basal half.

Habitat.—Japan (Honshiu).

Holotype, male, Matsuo, Iwate, altitude 3,250 feet, June 7, 1936 (*Yamamoto*).

Dicranota (*Rhaphidolabis*) *clausa* is so distinct from all other described species that it requires no comparison with any. The closed cell 1st M_2 is unique in the subgenus, while the excessive number of antennal segments is equalled only in the otherwise very distinct *D.* (*R.*) *polymera* Alexander. In its general appearance the present fly somewhat resembles *D.* (*R.*) *flavibasis* (Alexander), but is an entirely different fly. The presence of

a close cell 1st M_2 gives the fly somewhat the appearance of a member of the subgenus *Amalopina* Brunetti, but the reference to *Rhaphidolabis* seems undoubtedly to be the correct one.

HEXATOMINI

LIMNOPHILA (PRIONOLABIS) NIGROFEMORATA sp. nov. Plate 1, fig. 14; Plate 3, fig. 39.

Large (wing, male, over 10 millimeters); antennæ black throughout; thorax black, surface very sparsely pruinose; halteres elongate, knobs infuscated; legs black; wings broad, whitish, with a sparse pale-brown pattern; male hypopygium with caudal margin of tergite emarginate medially; outer dististyle with abundant microscopic spinulæ on outer margin; inner dististyle with a conspicuous arm on outer margin before apex, tip set with numerous blackened spinous points.

Male.—Length, 9 to 10 millimeters; wing, 10.5 to 11.5.

Rostrum and palpi black. Antennæ black throughout, 15-segmented, in the paratype with the basal two flagellar segments partly fused; flagellar segments oval, with verticils that slightly exceed the segments in length. Head black, surface sparsely pruinose.

Thorax black, præscutum a little dulled by a sparse pruinosity. Pleura dusted with gray. Halteres elongate, stem pale, knob strongly infuscated. Legs black throughout. Wings (Plate 1, fig. 14) broad; ground color whitish, prearcular and costal portions restrictedly pale yellow; stigma oval, brown; restricted pale brown seams along cord, outer end of cell 1st M_2, and vein Cu; veins pale brown, brighter in the flavous areas. Venation: R_{2+3+4} not in longitudinal alignment with Rs, being a little elevated; R_{1+2} and R_2 subequal; cell M_1 exceeding its petiole; m-cu beyond midlength of cell 1st M_2.

Abdomen, including hypopygium, black, surface scarcely pruinose. Male hypopygium (Plate 3, fig. 39) with caudal margin of tergite, *9t*, conspicuously emarginate medially. Outer dististyle, *od*, slender without a conspicuous flange on outer margin; in the type with a single well-developed tooth on mesal edge, in the paratype with two or three poorly-indicated denticles; outer margin of style with abundant microscopic appressed spinulæ. Inner dististyle, *id*, with a conspicuous arm on outer margin before apex, this set with numerous microscopic blackened spinous points. Gonapophyses, *g*, narrow, yellow. Ædeagus, *a*, greatly compressed but relatively broad in relation to the length.

Habitat.—Japan (Honshiu).

Holotype, male, Mount Nanshō, Iwate, altitude 2,600 feet, November 4, 1934 (*Kato*); collector's No. 5. Paratopotype, male.

Limnophila (*Prionolabis*) *nigrofemorata* is readily told by the large size, the black legs, and the structure of the male hypopygium, especially of the styli. In the Japanese fauna the species is exceeded in size only by *L.* (*P.*) *rufipennis* Alexander, which has the male hypopygium of quite distinct construction.

LIMNOPHILA (PRIONOLABIS) YAMAMOTANA sp. nov. Plate 1, fig. 15; Plate 3, fig. 40.

Small (wing, male, 7.5 millimeters); general coloration polished black; number of antennal segments variable; halteres yellow; fore femora with outer two-thirds blackened, middle and hind femora with tips narrowly darkened; wings weakly tinged with brownish, prearcular and costal regions light yellow; a restricted pale-brown pattern; male hypopygium with median area of tergite produced, its margin weakly trilobed; inner dististyle with a comb of four long teeth on outer margin before apex; gonapophyses narrow, dusky.

Male.—Length, about 6 millimeters; wing, 7.5.

Female.—Length, about 7.5 to 8 millimeters; wing, 7.

Rostrum and palpi black. Antennæ black throughout; antennal segments variable in number, in the holotype male 14-segmented, with basal two flagellar segments partly fused, terminal segment elongate and apparently the result of fusion. In the allotype female there appear to be only nine segments; paratype female with fifteen segments. Head black, sparsely pruinose.

Thorax black, dorsum somewhat polished, pleura slightly more pruinose but inconspicuously so. Halteres yellow. Legs with coxæ and trochanters black; fore femora yellow basally, with about the distal two-thirds blackened; remaining femora yellow, tips narrowly blackened, the amount including about the outer fifth or sixth; tibiæ obscure yellow, tips slightly darkened; tarsi passing through yellowish brown to black. Wings (Plate 1, fig. 15) moderately broad, with a weak brownish tinge, prearcular and costal fields light yellow; stigma dark brown; a restricted pale-brown pattern, including clouds at origin of Rs, cord, outer end of cell 1st M_2, and a seam along vein Cu; veins brown, brightened in the flavous areas. Venation: Cell M_1 subequal to or shorter than its petiole; m-cu close to midlength of cell 1st M_2.

Abdomen, including hypopygium, black. Male hypopygium (Plate 3, fig. 40) with median area of caudal margin of tergite, *9t*, a little produced, edge very insensibly trilobed to nearly truncate. Outer dististyle, *od*, with a single lateral spine; inner dististyle, *id*, with a comb of three long and a shorter outer spine before the abbreviated black tip. Gonapophyses, *g*, dusky, relatively narrow, outer third or fourth gradually narrowed, tip obtuse. Ovipositor with the cerci very long and slender, almost straight.

Habitat.—Japan (Honshiu).

Holotype, male, Matsuo, Iwate, altitude 1,625 feet, June 6, 1936 (*Yamamoto*). Allotopotype, female, with the type. Paratopotype, female, with the type.

This interesting *Prionolabis* is named in honor of the collector, Mr. Hiromu Yamamoto, to whom I express my thanks for valuable coöperation in studying the Japanese Tipulidæ. The nearest ally is *Limnophila* (*Prionolabis*) *odai* Alexander, which is likewise a species of small size, with the ninth tergite of the male hypopygium somewhat similarly produced and weakly trilobed. The present fly differs in the broadly darkened fore femora, brown-tinged wings, and the details of the male hypopygium, notably the inner dististyle and the narrow dusky gonapophyses. The variability in number of antennal segments in the present species is very surprising, and more material will be needed to show the true range in number of segments. It scarcely seems possible that the three specimens constituting the type series all represent teratological individuals.

HEXATOMA (ERIOCERA) INSIDIOSA sp. nov. Plate 1, fig. 16.

Belongs to the *verticalis* group; general coloration black, præscutum without stripes; antennæ (female) 8-segmented, scape and pedicel obscure brownish yellow, flagellum black; vertical tubercle simple; halteres black; fore femora chiefly black, remaining femora obscure brownish yellow, tips narrowly blackened; wings with a strong brown suffusion; stigma subcircular, darker brown; outer radial and medial veins with abundant trichia; R_{1+2} and R_2 subequal, the latter at fork of R_{2+3+4}; m-cu about one-third its length beyond fork of M; abdominal segments bicolorous, brown or brownish yellow, caudal margins black.

Female.—Length, about 12 millimeters; wing, 11.

Rostrum dark brown; palpi black. Antennæ (female) 8-segmented; scape and pedicel obscure brownish yellow, flagellum

black; flagellar segments cylindrical, gradually decreasing in length outwardly; two outermost segments subequal. Head with vertical tubercle bulbous, simple, dark brown; remainder of head more heavily pruinose.

Pronotum dark brown. Mesonotal præscutum uniformly black, subnitidous, without stripes; præscutal setæ very small and sparse; posterior sclerites of notum blackened, with a relatively sparse yellow or grayish yellow bloom. Pleura black, sparsely dusted with gray. Halteres black. Legs with coxæ black, sparsely dusted with gray; trochanters brownish yellow; fore femora black, bases narrowly obscure yellow; remaining femora obscure brownish yellow, tips narrowly blackened; tibiæ brownish black to black, tips blackened; tarsi black. Wings (Plate 1, fig. 16) with a strong brown suffusion; stigma subcircular, darker brown; longitudinal veins very indistinctly and vaguely seamed with dusky; veins dark. Costa with long coarse trichia; veins R_{2+3+4}, R_3, R_4, R_5, and outer sections of M_{1+2} and M_3 with conspicuous trichia. Venation: R_{1+2} and R_2 subequal, latter at fork of R_{2+3+4}; Rs relatively long, fully twice R_{2+3+4}; m-cu about one-third its length beyond fork of M, subequal to distal section of Cu_1.

Abdominal segments bicolorous, sternites more distinctly so than tergites, both pale brown or brownish yellow, with the caudal half to third of individual segments blackened; genital shield dark brown; valves of ovipositor elongate, brownish yellow; hypovalvæ blackened at bases.

Habitat.—China (Kwangtung).

Holotype, female, Loh Fau Shan, near the Wa Shan Tói Monastery, in woods, altitude about 800 feet, April 27, 1936 (*Tinkham*).

The nearest ally of the present fly is *Hexatoma* (*Eriocera*) *nipponensis* (Alexander), of Japan, which has similar trichia on the outer wing veins but differs conspicuously in the coloration of the body. *H.* (*E.*) *nigrina* (Riedel) and *H.* (*E.*) *verticalis* (Wiedemann) have the veins beyond cord, with the exception of the outer section of R_5, without trichia.

HEXATOMA (ERIOCERA) MIRANDA sp. nov. Plate 1, fig. 17.

Belongs to the *dichroa* group; general coloration black; antennæ (male) 7-segmented, terminal segment more than one-half length of penultimate; mesonotal præscutum with four reddish brown stripes that are narrowly bordered by velvety black; halteres and legs black; wings long and narrow, dark brown, with

a narrow yellow crossband before cord; bases of anal cells conspicuously light yellow; R_{1+2} very long, considerably exceeding the long R_{2+3+4}; cell M_1 longer than its petiole; abdomen velvety black, tergites two to five deep orange, except the base of tergite two and the apex of tergite five.

Male.—Length, about 17 millimeters; wing, 19.5; antenna, about 3.5.

Rostrum and palpi black. Antennæ (male) 7-segmented, black throughout; flagellar segments very gradually decreasing in length outwardly, segment five more than one-half length of penultimate. Head black, sparsely gray pruinose, with coarse black setæ; a slender median vertical tubercle, with paired smaller tubercles on either side behind antennal bases.

Pronotum black, pruinose. Mesonotal præscutum with ground color grayish, with four reddish brown stripes that are narrowly bordered by velvety black; setæ of interspaces long and erect; posterior sclerites of mesonotum brownish black. Pleura brownish black, dorsopleural membrane even darker. Halteres black. Legs black throughout. Wings (Plate 1, fig. 17) long and narrow, about four and one-half times as long as wide; ground color dark brown, including prearcular and costal regions; a narrow but conspicuous yellow crossband before cord, extending from vein R_1 to posterior margin, a little suffused and interrupted along vein M; bases of both anal cells conspicuously pale yellow, including about proximal third of cell 2d A; veins yellowish brown to brown, clearer luteous in yellow areas. Costa with abundant trichia; R_{2+3+4} and R_{3+4}, together with outer medial veins, almost without trichia, a few scattered trichia near outer end. Venation: Rs a little shorter than R, about twice R_{2+3+4}; R_{1+2} unusually long, considerably exceeding R_{2+3+4}; cell M_1 longer than its petiole; m-cu shortly beyond midlength of cell 1st M_2.

Abdomen uniform velvety black, with the exception of tergites two to five which are deep orange, base and sides of tergite two and apex of tergite five velvety black; hypopygium black; abdominal tergites without differentiated basal rings.

Habitat.—Western Java.

Holotype, male, Goenoeng Besser, Mount Djampangs, May, 1936 (*Walsh*).

Hexatoma (*Eriocera*) *miranda* is very distinct from all other members of the *dichroa* group in the conspicuously banded wings. In the latter feature the fly somewhat resembles *H.* (*E.*) *meso-*

pyrrha (Wiedemann), but belongs to an entirely different group of species, being more nearly allied to *H.* (*E.*) *ferruginosa* (van der Wulp).

HEXATOMA (ERIOCERA) CELESTIA sp. nov. Plate 1, fig. 18.

Belongs to the *nepalensis* group; general coloration opaque black; antennæ (male) 8-segmented, black throughout; femora yellow, tips narrowly black, the amount subequal on all legs; wings dark brown, with a conspicuous whitish hyaline crossband extending from costa obliquely backward almost to vein Cu, widest in cells R and M; anal cells and central portion of cell Cu abruptly paler than ground; R_2 transverse; cell M_1 lacking; basal portions of intermediate tergites more nacreous and shiny.

Male.—Length, about 20 millimeters; wing, 16; antennæ, 5.

Rostrum black; palpi relatively long, black throughout. Antennæ (male) 8-segmented, black throughout; flagellar segments gradually decreasing in length and diameter, last two subequal. Head black; vertical tubercle inconspicuous; setæ on occipital region long and conspicuous.

Thorax entirely black, without stripes; præscutal setæ erect, small, inconspicuous. Halteres black. Legs with coxæ and trochanters black; femora yellow, tips narrowly (2 millimeters) black, the amount subequal on all legs; tibiæ obscure yellow, tips narrowly blackened; basitarsi brown, tips blackened; remaining tarsal segments black. Wings (Plate 1, fig. 18) dark brown, including prearcular field; cell C, basal half of Sc, and basal portion of R_1 more yellowish brown; an oblique, whitish-hyaline crossband before cord, beginning at costa at end of Sc, very narrow in cells Sc_1 and R_1, much wider and forming an oval area in outer ends of cells R and M, not quite attaining vein Cu posteriorly; small pale areas before origin of Rs in cell R and in cell R_4 adjoining vein R_4; anal cells abruptly grayish, confluent with a whitish hyaline area at midlength of cell Cu; veins dark brown, brighter in the yellow costal portions. Numerous macrotrichia on veins R_3, R_4, and distal section of R_5; more sparse trichia on distal ends of outer branches of M. Venation: Rs long, nearly twice R; R_{1+2} about twice R_{2+3}; R_2 transverse; R_{2+3+4} shorter than R_{1+2}; cell M_1 lacking; m-cu beyond two-thirds length of cell 1st M_2.

Abdomen black, basal portions of intermediate tergites broadly more nacreous and shiny; sternites, subterminal tergites, and hypopygium more uniformly opaque black.

Habitat.—China (Kwangtung).

Holotype, male, Gow Bo Shan, Sui Hit Chi, Yue Hing Ying, Sixth District, on mountain grass, July 4, 1936 (*Tsz Hai*).

Hexatoma (*Eriocera*) *celestia* is very different from other regional members of the subgenus, the abrupt paling of the anal cells and the nearly hyaline central portion of cell Cu contrasting conspicuously with the dark ground color of the wing. By Edwards's key to the Old World species of *Eriocera*,[7] the species runs to *hilpa* (Walker), a very distinct fly.

HEXATOMA (ERIOCERA) AMBROSIA sp. nov. Plate 1, fig. 19.

Belongs to the *nepalensis* group; general coloration black, præscutum with three polished black stripes; antennæ (female) 11-segmented; femora yellow, tips narrowly blackened, the amount subequal on all legs; wings dark brown, costal portion conspicuously yellow; a narrow, whitish hyaline crossband before cord; numerous trichia on veins beyond cord; cell M_1 lacking; bases of abdominal tergites polished; genital segment fiery orange.

Female.—Length, about 17 millimeters; wing, 12; antenna, 3.5.

Rostrum and palpi black. Antennæ (female) 11-segmented, black throughout; flagellar segments one to six gradually decreasing in length and thickness; terminal three segments short, subequal in length. Head dull black, very sparsely pruinose; vertical tubercle low and simple; vertex with abundant long coarse setæ.

Pronotum dull black. Mesonotal præscutum with restricted interspaces dull black, disc chiefly covered by three polished black stripes; setæ restricted to posterior half of præscutal interspaces, long, conspicuous, erect; posterior sclerites of mesonotum chiefly polished black. Pleura and pleurotergite dull black. Halteres black throughout. Legs with coxæ and trochanters black; femora bright yellow, tips narrowly (less than 1 millimeter) and abruptly blackened, the amount subequal on all legs and involving distal eighth to tenth of segment; tibiæ and basitarsi yellowish brown, tips narrowly brownish black; remainder of tarsi black. Wings (Plate 1, fig. 19) with ground color dark brown; anal cells more grayish, but vicinity of vein 2d A somewhat clouded; costal border conspicuously yellow, involving cell Sc and much of cell R_1 beyond origin of Rs, the

[7] Ann. & Mag. Nat. Hist. IX 8 (1921) 70–78.

latter portion of the area crossing Rs into margin of cell R; cell C more brownish yellow, clearer yellow at ends; a narrow whitish hyaline crossband before cord, extending from vein R_1 into cell Cu, nearly parallel-sided except at either end, distal edge touching fork of Rs; veins dark brown, more yellowish in brightened areas. Costa with very abundant trichia; veins beyond cord with numerous trichia, involving both radial and medial fields; Cu virtually without trichia; distal ends of Rs and M with sparse long trichia. Venation: h nearly transverse; Sc_2 some distance before tip of Sc_1, lying before fork of Rs; R_2 and R_{2+3} subequal, the former a little oblique; cell M_1 lacking; m-cu beyond midlength of lower face of cell 1st M_2, in one wing of type more distad than in the other.

Abdomen opaque black, tergites two to seven, inclusive, with polished, more plumbeous, basal rings; sternites more uniformly opaque black, polished bases narrow and ill-defined; genital shield fiery orange; cerci elongate, yellowish horn-colored.

Habitat.—China (Kwangtung).

Holotype, female, Gow Bo Shan, Sui Hit Chi, Yue Hing Ying, Sixth District, July 2, 1936 (*Tsz Hai*).

By Edwards's key to the Old World species of *Eriocera*[8] the present fly runs to *Hexatoma* (*Eriocera*) *hilpa* (Walker), an entirely distinct fly. The nearest regional species would appear to be *H.* (*E.*) *celestia* sp. nov., which differs especially in the opaque præscutal stripes and in the pattern of the legs and wings.

HEXATOMA (ERIOCERA) CANTONENSIS sp. nov. Plate 1, fig. 20.

General coloration black, præscutum with four more polished black stripes; head and mesonotum with coarse black setæ; antennæ, halteres, and legs black; wings blackish, with a conspicuous, more yellow brightening before cord, apical cells darkened; cell M_1 present but variable in length; hypopygium black; genital shield of ovipositor orange.

Male.—Length, 10 to 16 millimeters; wing, 10.5 to 16; antenna, 3.5 to 4.

Female.—Length, 20 to 22 millimeters; wing, 15 to 17; antenna, 4.

Rostrum and palpi black. Antennæ of male 8-segmented, of female 9-segmented, black throughout; flagellar segments cylindrical, gradually decreasing in length outwardly, last two sub-

[8] loc. cit.

equal. Head black, with coarse black setæ; vertical tubercle relatively low and inconspicuous.

Thorax opaque black; præscutum with four more polished black stripes, the intermediate pair separated only by a narrow velvety black line; posterior portion of præscutum with long black setæ, chiefly on interspaces but including the posterior ends of the intermediate stripes; centers of scutal lobes somewhat polished. Pleura black. Halteres and legs black throughout. Wings (Plate 1, fig. 20) with a blackish tinge, more grayish in the cubital and anal cells; a more yellowish, ill-delimited brightening before cord, including parts of cells R_1, R, and M, merging very insensibly with the ground; veins black. Abundant macrotrichia on veins beyond cord, fewer and more scattered on M_3 and M_4; costal setæ dense in both sexes. Venation: R_{2+3+4} shorter than R_{2+3}; R_{1+2} relatively long, from one and one-half to two times R_{2+3+4}; inner end of cell 1st M_2 arcuated to angulated; cell M_1 small, variable in length, in abnormal cases and including one wing of the holotype, lost by fusion of veins M_1 and M_2 to margin; m-cu at or before midlength of cell 1st M_2.

Abdomen, including hypopygium, black, without differentiated tergal rings. Female with genital shield orange; ovipositor ferruginous; cerci long and slender.

One female (Sui Hit Chi, Gow Bo Shan, northern Kwangtung, May 15, 1936) has the wings, with the exception of the costal border and cells beyond cord, chiefly obscure yellow, and R_2 somewhat more oblique. I consider this individual a variant of the present fly.

Habitat.—China (Kwangtung, Kiangsi).

Holotype, male, north side of Paak Wan Shan (White Cloud Mountain), Canton, near stream, altitude 200 to 500 feet, April 28, 1936 (*Tsz Hai*). Allotopotype, female. Paratopotypes, several males and females, April 28 to May 4, 1936 (*Tsz*). Paratype, 1 male, Kuling, Kiangsi, altitude 3,250 feet, August 27, 1935 (*Monteil*); in the Musée Heude, Shanghai.

The present fly is most closely allied to *Hexatoma* (*Eriocera*) *morula* (Alexander), of Szechwan, western China, which has the outer medial cells of the wings pale and the venational details distinct. In the latter fly Cu_2 is very short, about one-half m-cu, and bent strongly caudad, widening cell M_4, while the inner end of cell 1st M_2 is not arcuated. The possibility is not excluded that the present fly is only racially distinct from *morula*.

ELEPHANTOMYIA (ELEPHANTOMYODES) EGREGIA de Meijere.

Elephantomyia egregia DE MEIJERE, Tijd. voor Ent. 56 (1913) 347, 348.

The type, a male, was from Nongkodjadjar, in the Tengger Mountains, eastern Java, collected in January by Jacobson. The still undescribed female is discussed below.

Female.—Length, excluding rostrum, about 9 millimeters; wing, 6.5; rostrum, about 4.

Characters as in the male, as described and figured by de Meijere, with the following differences: Flagellar segments long-oval, all but basal ones with very long verticils. Pronotum and dorsopleural region dark brown, mesepisternum weakly infumed, remainder of pleura, together with pleurotergite and lateral borders of mediotergite, light yellow. Legs black, femoral bases restrictedly brightened; basitarsi black, outer ends abruptly snowy white; succeeding tarsal segments snowy white, last segment infuscated. Wings with the pattern described by de Meijere, but the pale areas in cell R not oval but rectangular to quadrate in outline, like remaining pale areas on disc; pale area in cell R_1 only about one-half as long as the one immediately beneath it in the outer end of cell R. Venation: m-cu at midlength of cell 1st M_2; cell 2d A long and narrow, parallel-sided for virtually its whole length, not narrowed and obliterated at proximal end as figured by de Meijere.

Allotype, female, Mount Ardjano, eastern Java, altitude 6,000 to 7,000 feet, January, 1936 (*Walsh*).

ELEPHANTOMYIA (ELEPHANTOMYODES) MACKERRASI Alexander.

Elephantomyia (Elephantomyodes) mackerrasi ALEXANDER, Philip. Journ. Sci. 53 (1934) 287, 288.

The types were from Mount Malabar, Java, altitude 4,000 feet, collected in May by Mackerras. One male, Soember Brantas, Mount Ardjano, eastern Java, altitude 6,000 feet, January 14 to 25, 1936 (*Walsh*). The coloration of the mesonotum is a little darker than in the type.

ERIOPTERINI

Genus GONOMYIA Meigen

Gonomyia MEIGEN, Syst. Beschr. 1 (1818) 146.

Characters as in the subgenus *Idiocera* Dale (*Ptilostena* Bergroth), differing in the presence of a supernumerary crossvein in cell R_4 of the wing beyond midlength (Plate 1, fig. 21).

Type of subgenus.—*Gonomyia (Euptilostena) reticulata* Alexander (Eastern Palæarctic Region).

Other members of the group include *G.* (*E.*) *jucunda* Loew (Western Palæarctic) and *G.* (*E.*) *supernumeraria* sp. nov. (Oriental).

In case *Idiocera* Dale is recognized as a genus distinct from *Gonomyia* Meigen, the present group will deserve subgeneric ranking in it. Edwards has recently made the discovery that the name *Idiocera* Dale, overlooked by Kertész and other cataloguers of the Tipulidæ, is the correct name for what has long been called *Ptilostena.* Of the various groups that have been proposed in the older group *Gonomyia, Lipophleps* Bergroth and *Gonomyia* Meigen lack the anterior arculus of the wings, while the remaining groups, *Protogonomyia* Alexander, *Progonomyia* Alexander, *Ellipterodes* Becker, *Ptilostenodes* Alexander, *Idiocera* Dale, and *Euptilostena* subgen. nov., have this present.

GONOMYIA (EUPTILOSTENA) SUPERNUMERARIA sp. nov. Plate 1, fig. 21.

General coloration of mesonotum gray, præscutum faintly lined with brown; antennæ black, pedicel paler; pleura yellow, darkened dorsally; halteres brownish black; legs yellow; wings whitish, faintly suffused with brown; a heavy brown pattern restricted to the vicinity of the veins; abdominal tergites dark brown, caudal margins narrowly ringed with pale; hypovalvæ of ovipositor black.

Female.—Length, about 7 millimeters; wing, 6.

Rostrum black; palpi brownish black. Antennæ with scape brownish black; pedicel obscure brownish yellow; flagellum black; flagellar segments long-oval, verticils exceeding segments. Front and anterior vertex obscure yellow; posterior vertex gray pruinose; anterior vertex with a more darkened median area.

Mesonotum dark, light gray pruinose, præscutum with indications of darker stripes; scutellum more brownish yellow. Pleura obscure yellow, dorsal pleurites and pleurotergite more blackened. Halteres brownish black. Legs with fore coxæ darkened, remaining coxæ and all trochanters yellow; remainder of legs yellow, outer tarsal segments darkened. Wings (Plate 1, fig. 21) whitish, with a weak brown suffusion, prearcular and costal portions more luteous; a restricted dark-brown pattern arranged as follows: Origin of Rs, stigma, anterior cord, supernumerary crossvein in cell R_4, distal section of vein R_4, and m-cu; veins pale brown, darker in the clouded areas, more yellowish in the luteous portions. Venation: Sc_1 ending just beyond origin of Rs, Sc_2 far from its tip, at near three-fifths the distance between arculus and origin of Rs; R_{1+2} and R_3 only narrowly separated

along costal margin; distal section of vein R_4 and supernumerary crossvein subequal in length, in nearly transverse alignment; m-cu about one and one-half times its length before fork of M.

Abdominal tergites dark brown, caudal margins narrowly ringed with pale, broader and more yellow on basal two or three segments, becoming narrower and more obscure on outer tergites; sternites paler, obscure yellow, especially on outer segments; pleural membrane yellow. Genital shield and cerci pale; hypovalvæ powerfully constructed, black.

Habitat.—Western Java.

Holotype, female, Goenoeng Besser, Djampangs, April, 1936 (*Walsh*).

Gonomyia (*Euptilostena*) *supernumeraria* is readily told from all regional species of the genus by the subgeneric character of a supernumerary crossvein in the wings. In the general nature of the wing pattern the fly most resembles species such as *Gonomyia* (*Idiocera*) *punctipennis* Edwards.

GONOMYIA (LIPOPHLEPS) BIACULEATA sp. nov. Plate 1, fig. 22; Plate 3, fig. 41.

Belongs to the *incompleta* group; flagellar segments with a dense white pubescence; male hypopygium with the dististyle narrow, with two unusually long and slender blackened spines.

Male.—Length, about 3 millimeters; wing, 3.5.

Rostrum testaceous brown; palpi darker. Antennæ with scape testaceous, remaining segments black; flagellar segments with a long white pubescence but without elongate verticils. Head dark gray.

Pronotum dark brown. Mesonotal præscutum above dark brown, somewhat deeper in front, humeral portion yellow; posterior sclerites of notum dark brown. Pleura testaceous-yellow, anterior sclerites a little darker. Halteres dusky, stem yellow at base. Legs with fore coxæ darkened, remaining coxæ and all trochanters yellow; remainder of legs dark brown to black. Wings (Plate 1, fig. 22) with a brown tinge; stigma oval, a trifle darker brown; veins brown. Venation: Sc_1 ending a short distance before origin of Rs, distance on costa about one-half Rs alone; cell 1st M_2 strongly narrowed at proximal end.

Abdomen brown; hypopygium obscure yellow. Male hypopygium (Plate 3, fig. 41) with apical lobe of basistyle, *b*, stout, shorter than remainder of style. Dististyle, *d*, with the body very narrow, bearing two slender blackened spines, the outer stouter and nearly twice as long as the inner. Phallosome, *p*, as in *incompleta* and allies.

Habitat.—Central Java.

Holotype, male, Nglirip, djati forests, altitude 300 feet, January 1 to 7, 1936 (*Walsh*).

Gonomyia (*Lipophleps*) *biaculeata* is most nearly related to *G.* (*L.*) *bimucronata* Alexander (Luzon). Both species have the dististyles of the two sides symmetrical, in this respect differing from *incompleta* and allies where the dististyles are slightly asymmetrical and of very different conformation. In the present fly the body of the dististyle is very narrow, less than the length of either spine, whereas in *bimucronata* the spines are shorter and stouter, with the body of the structure much wider, nearly as wide as the total length of the outer spine alone.

GONOMYIA (LIPOPHLEPS) HORRIFICA sp. nov. Plate 1, fig. 23; Plate 3, fig. 42.

Belongs to the *alboannulata* group; mesonotum dark brown, scutellum yellow on posterior margin; femora with a broad black, nearly terminal ring; wings pale gray, unmarked; Sc_1 ending a short distance before origin of Rs; basal section of R_5 long; male hypopygium with three dististyles, the middle shorter than the outer, at apex with about a dozen powerful spines; inner dististyle bispinous; phallosome with the outer lateral arms appearing as flattened pale horns.

Male.—Length, about 3 to 3.2 millimeters; wing, 3.2 to 3.5.

Female.—Length, about 4 millimeters; wing, 4.

Rostrum and palpi black. Antennæ black; verticils (male) elongate. Head above yellow, darkened medially.

Pronotum yellow, restrictedly darkened medially. Pretergites narrowly china white. Mesonotal præscutum and scutum dark brown; scutellum dark brown, margined posteriorly with yellow; mediotergite dark, heavily pruinose, lateral margin on cephalic half restrictedly brightened; pleurotergite chiefly yellow. Pleura black, sparsely pruinose; dorsopleural region a trifle paler; a very conspicuous, yellowish white, longitudinal stripe extending from fore coxæ to base of abdomen, passing above middle and posterior coxæ. Halteres obscure yellow, knob chiefly dark brown, its apex a little brightened. Legs with fore coxæ white, midcoxæ obscure yellow, basal half blackened, posterior coxæ obscure yellow, slightly darkened at base; trochanters yellow; femora brownish yellow to brown, with a broad black ring, preceded by a very narrow clearer ring; on fore and middle femora the black rings are terminal, on the posterior femora subterminal, the apex narrowly yellow; tibiæ obscure yellow,

extreme base and slightly more extensive apex blackened; tarsi black, basitarsi on proximal end slightly paler. Wings (Plate 1, fig. 23) with a pale gray tinge, unmarked; veins pale, those at cord a little darker. Venation: Sc_1 ending a short distance before origin of Rs, Sc_2 close to its tip; Rs strongly arcuated; basal section of R_5 long, about two-thirds r-m; cell 1st M_2 closed; m-cu before fork of M; cell 2d A wide.

Abdominal tergites dark brown, sternites paler; hypopygium brownish yellow. Male hypopygium (Plate 3, fig. 42) with outer dististyle, *od*, a blackened, paddlelike blade. Middle dististyle, *md*, only about four-fifths the length of outer, basal half slender, apex more dilated, bearing about a dozen powerful spines, the outer ones larger. Inner dististyle, *id*, bispinous, outer or lateral spine longer. Phallosome, *p*, with outer lateral arms appearing as pale flattened horns, with pale membrane along their inner or mesal margin. In the Tjolo paratypes the middle dististyle is more slender, with the teeth somewhat more appressed; spines of the inner style closer together.

Habitat.—Java.

Holotype, male, Soekaboemi, western Java, altitude 1,800 feet, February, 1934 (*Walsh*). Allotype, female, Tjolo, Goenoeng Moeria, northern Java, altitude 2,100 feet, December 1 to 8, 1935 (*Walsh*). Paratopotypes, 3 males, with the allotype.

The nearest allied species is *Gonomyia* (*Lipophleps*) *acuspinosa* Alexander, of western Sumatra, which has the details of the hypopygium quite distinct, the middle dististyle being equal in length to the outer and with a row of abundant small spines occupying almost the entire length of the style.

STYRINGOMYIA BICORNUTA sp. nov. **Plate 1, fig. 24; Plate 3, figs. 43 to 46.**

General coloration black, dorsopleural membrane pale; halteres black; legs black, extreme bases of femora and tibiæ and posterior basitarsi paler; wings with proximal half whitish, distal portion somewhat more clouded; darker seams along vein Cu and on anterior cord; costal fringe (male) unusually long and conspicuous; abdomen black, pleural membrane yellow; male hypopygium with the tergite produced caudad into two slender divergent horns.

Male.—Length, about 8 millimeters; wing, 5.

Rostrum blackish; palpi black. Antennæ with scape and pedicel black; flagellum weakly bicolored, brownish black, incisures slightly pale. Head black; bristles inconspicuous.

Pronotum black, paler laterally, with a pair of major setæ. Mesonotum black, præscutum sublaterally slightly gray pruinose;

mesonotal bristles slender, relatively inconspicuous. Pleura brown, dorsopleural region obscure yellow. Halteres black throughout. Legs black, extreme femoral and tibial bases obscure yellow; posterior basitarsi dirty white on basal two-thirds, remainder darker. Wings (Plate 1, fig. 24) with proximal half whitish, distal portion somewhat more clouded; a seam along vein Cu and a cloud on anterior cord darker; veins brown, darker in the clouded areas. Costal fringe (male) unusually long and conspicuous, erect, setæ gradually decreasing in length outwardly, becoming of normal length near wing tip. Venation: Anterior branch of Rs suberect; cell 1st M_2 relatively wide (compared to *holomelania*), shorter than cell 2d M_2 beyond it, the latter in punctiform contact with cell 1st M_2 to narrowly sessile; m-cu oblique, about its own length beyond fork of M; vein 2d A arcuated on distal portion.

Abdomen black, only pleural membrane yellow. Male hypopygium with tergite (Plate 3, fig. 43, *t*) produced into two slender blackened horns. Sternite (Plate 3, fig. 44, 9*s*) narrow, at apex bearing the usual two strong bristles, placed rather close together at tip of median lobe. Basistyle (Plate 3, fig. 45, *b*) with two flattened spinous bristles, the outer from the summit of the usual apical lobe; second bristle sessile, widely separated from the first, at mesal-apical portion of basistyle. Dististyle (Plate 3, fig. 46, *d*) complex, as illustrated; outer arm, *od*, without spinous armature.

Habitat.—Eastern Java.

Holotype, male, Soember Brantas, altitude 6,000 feet, January 25, 1935 (*Walsh*).

Styringomyia bicornuta somewhat resembles *S. melania* Edwards (Western Java) and *S. holomelania* Alexander (Assam) in the extensive black coloration of the body and legs, differing in the very distinct structure of the male hypopygium, notably of the tergite.

ILLUSTRATIONS

[Legend: *a*, Ædeagus; *b*, basistyle; *d*, dististyle; *g*, gonapophysis; *i*, interbase; *id*, inner dististyle; *md*, middle dististyle; *od*, outer dististyle; *p*, phallosome; *s*, sternite; *t*, tergite.]

PLATE 1

FIG. 1. *Plocimas magnificus* Enderlein; venation.
2. *Pselliophora kangeanensis* sp. nov.; venation.
3. *Pselliophora biaurantia* sp. nov.; venation.
4. *Pselliophora upsilon* sp. nov.; venation.
5. *Tipula (Tipulodina) amabilis* sp. nov.; venation.
6. *Tipula (Vestiplex) takahashiana* sp. nov.; venation.
7. *Tipula (Vestiplex) niitakensis* sp. nov.; venation.
8. *Nephrotoma pallidapex* sp. nov.; venation.
9. *Dolichopeza (Dolichopeza) katoi* sp. nov.; venation.
10. *Dolichopeza (Nesopeza) thisbe* sp. nov.; venation.
11. *Dicranoptycha stygipes* sp. nov.; venation.
12. *Protohelius tinkhami* sp. nov.; venation.
13. *Dicranota (Rhaphidolabis) clausa* sp. nov.; venation.
14. *Limnophila (Prionolabis) nigrofemorata* sp. nov.; venation.
15. *Limnophila (Prionolabis) yamamotana* sp. nov.; venation.
16. *Hexatoma (Eriocera) insidiosa* sp. nov.; venation.
17. *Hexatoma (Eriocera) miranda* sp. nov.; venation.
18. *Hexatoma (Eriocera) celestia* sp. nov.; venation.
19. *Hexatoma (Eriocera) ambrosia* sp. nov.; venation.
20. *Hexatoma (Eriocera) cantonensis* sp. nov.; venation.
21. *Gonomyia (Euptilostena) supernumeraria* sp. nov.; venation.
22. *Gonomyia (Lipophleps) biaculeata* sp. nov.; venation.
23. *Gonomyia (Lipophleps) horrifica* sp. nov.; venation.
24. *Styringomyia bicornuta* sp. nov.; venation.

PLATE 2

FIG. 25. *Plocimas magnificus* Enderlein; antenna, female.
26. *Tipula (Vestiplex) bicornigera* sp. nov.; male hypopygium, ninth tergite.
27. *Tipula (Vestiplex) bicornigera* sp. nov.; male hypopygium, styli.
28. *Tipula (Oreomyza) niitakensis* sp. nov.; male hypopygium, lateral aspect.
29. *Tipula (Oreomyza) niitakensis* sp. nov.; male hypopygium, ninth tergite.
30. *Tipula (Oreomyza) niitakensis* sp. nov.; male hypopygium, styli.
31. *Nephrotoma nigrocentralis* sp. nov.; male hypopygium, ninth tergite.
32. *Nephrotoma nigrocentralis* sp. nov.; male hypopygium, styli.
33. *Nephrotoma pallidapex* sp. nov.; male hypopygium, outer dististyle.

FIG. 34. *Nephrotoma pallidapex* sp. nov.; male hypopygium, inner dististyle.
35. *Dolichopeza* (*Dolichopeza*) *katoi* sp. nov.; male hypopygium.
36. *Dolichopeza* (*Nesopeza*) *thisbe* sp. nov.; male hypopygium, details.

PLATE 3

FIG. 37. *Protohelius tinkhami* sp. nov.; male hypopygium.
38. *Dicranota* (*Rhaphidolabis*) *clausa* sp. nov.; male hypopygium.
39. *Limnophila* (*Prionolabis*) *nigrofemorata* sp. nov.; male hypopygium.
40. *Limnophila* (*Prionolabis*) *yamamotana* sp. nov.; male hypopygium.
41. *Gonomyia* (*Lipophleps*) *biaculeata* sp. nov.; male hypopygium.
42. *Gonomyia* (*Lipophleps*) *horrifica* sp. nov.; male hypopygium.
43. *Styringomyia bicornuta* sp. nov.; male hypopygium, tergite.
44. *Styringomyia bicornuta* sp. nov.; male hypopygium, sternite.
45. *Styringomyia bicornuta* sp. nov.; male hypopygium, styli.
46. *Styringomyia bicornuta* sp. nov.; male hypopygium, dististyle.

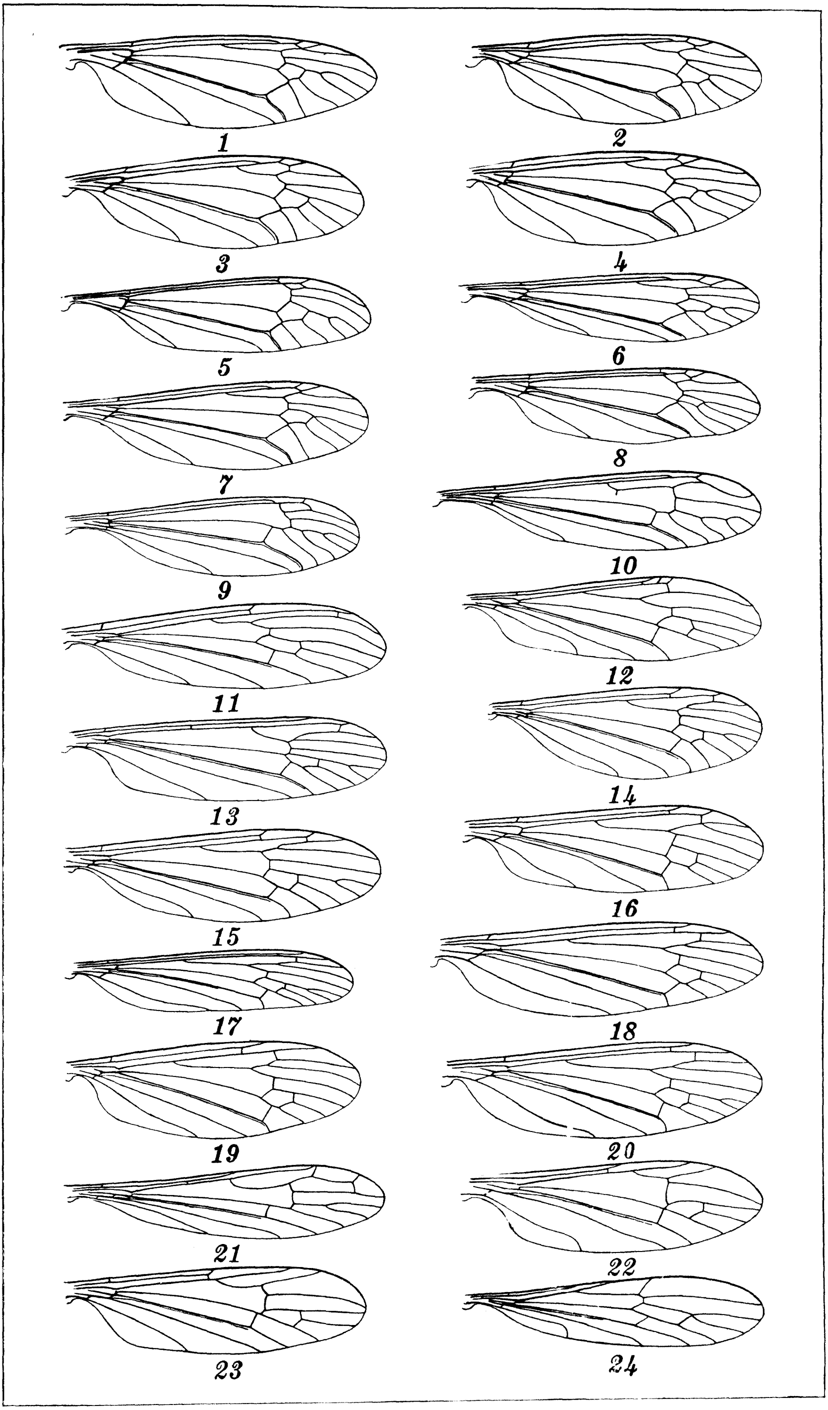

PLATE 1.

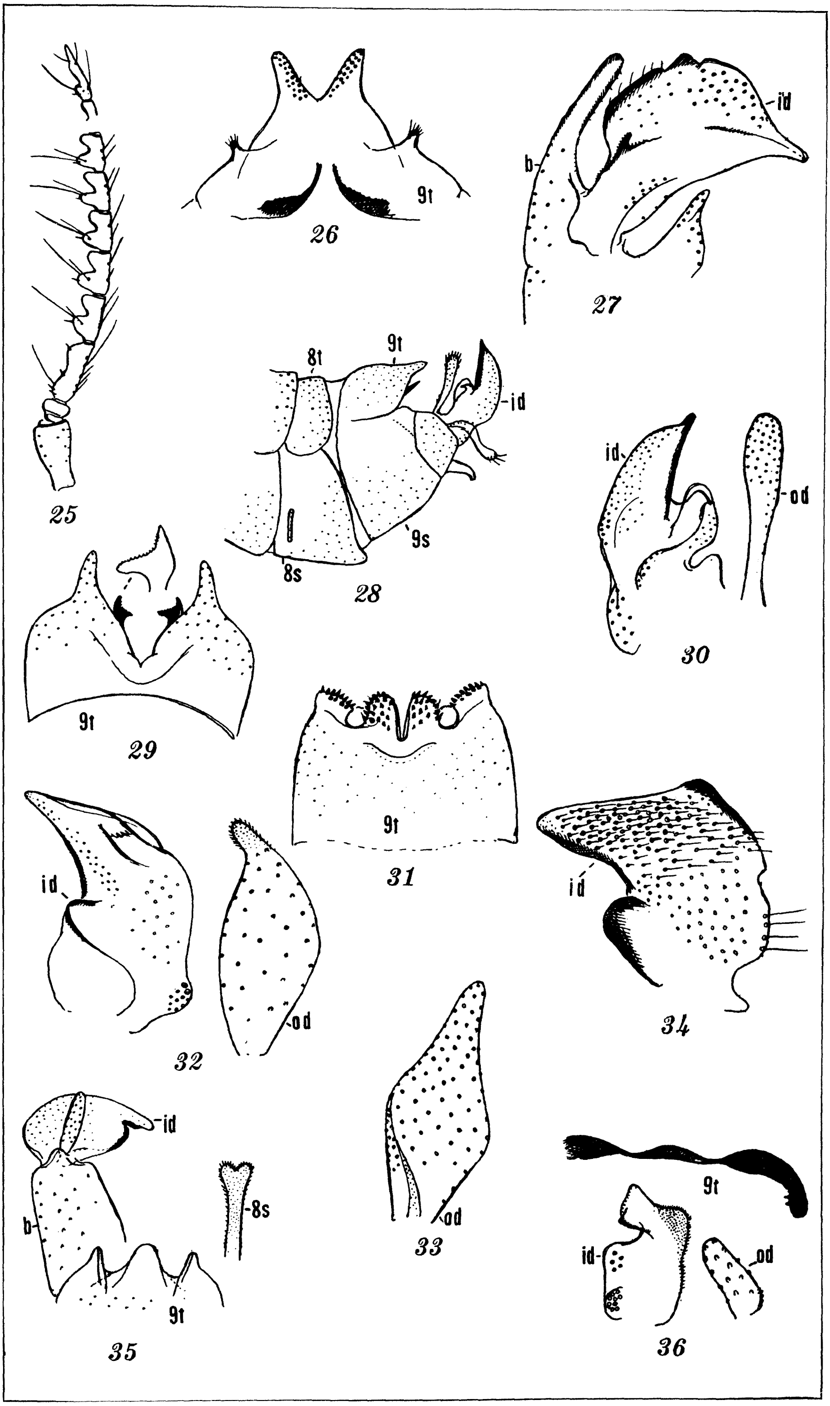
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PLATE 2.

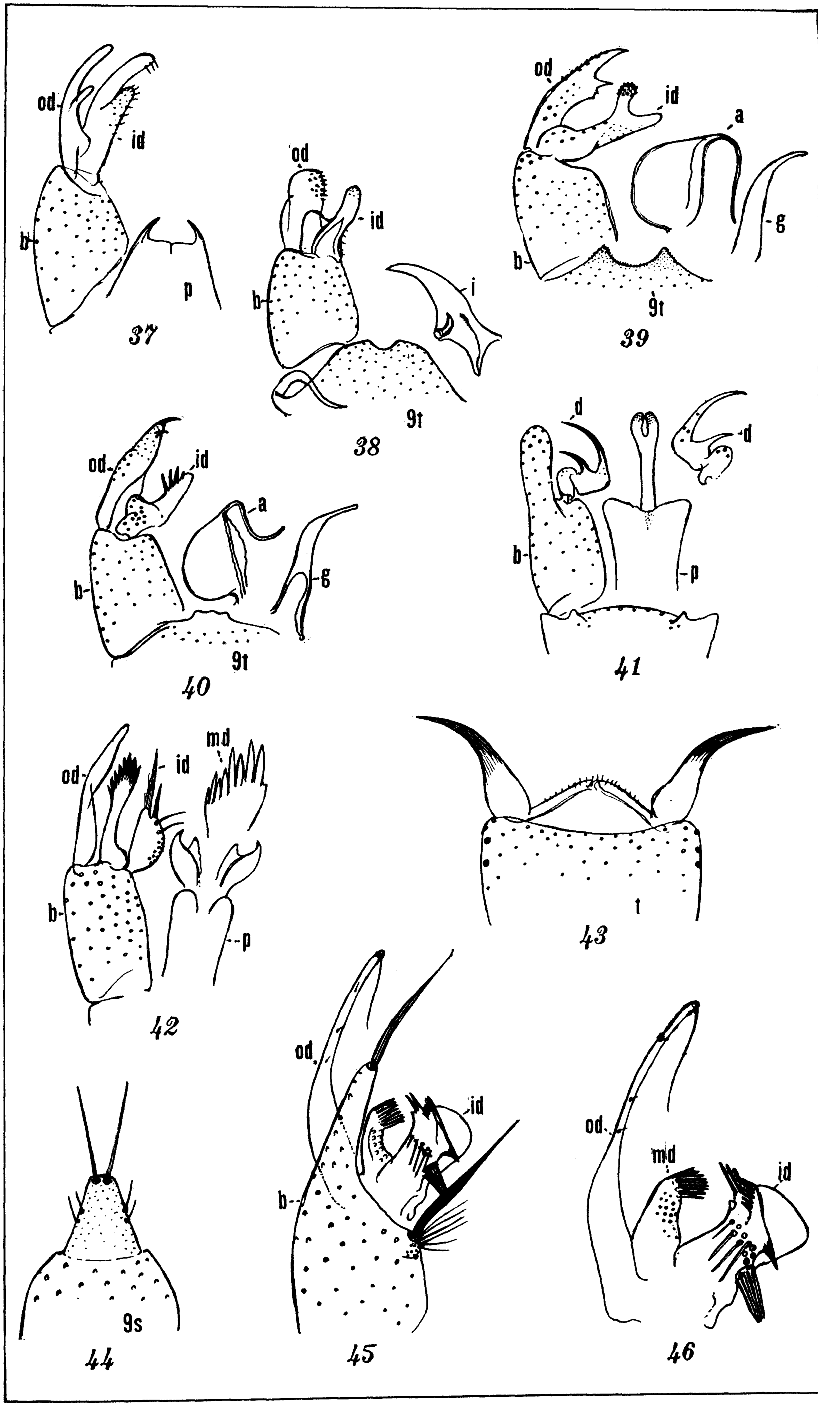
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PLATE 3.

BOOKS

Acknowledgment of all books received by the Philippine Journal of Science will be made in this column, from which a selection will be made for review.

REVIEWS

Sickness and Insurance; A Study of the Sickness Problem and Health Insurance. By Harry Alvin Millis. Chicago, The University of Chicago Press. c1937. 166 pp., tables. Price, $2.

This little volume contains a clear and concise presentation of the social and economic problems created by sickness, and outlined suggestions for their solution. Mr. Millis discusses the sickness problem in the United States, and the various methods employed by the different underwriters, and shows the defects of the systems and the resulting tendency of group hospitalization and private-group medical clinics.

In his discussion of the cost of illness in the United States the author emphasizes that the problem of sickness in America is ranking next in importance to unemployment. His data, figures, and statistics show that families in the low-income group have the highest rate of disabling sickness, and are unable to meet the medical financial obligations of prolonged illness. Because of the insistent need for security against sickness, compulsory health insurance was adopted. Benefits provided by this system are: Cash benefit for lost income, medical services, and maternity and burial benefits in the majority of cases.

The author reviews the origin and development of compulsory health insurance in various European countries. The operation of the system depends upon the needs of each locality. He lays most emphasis on the system and experiences therewith in Germany, England, and France, citing their defects, which are difficult to correct. In England, compulsory health insurance has become a definitely established institution, rendering a new service to the masses.

In the latter part of the book the author makes a more extensive study of the present movement for and management of compulsory health insurance in America. He clearly presents both sides of the question, citing the reports of various com-

mittees who studied the problems of compulsory health insurance. The author's suggestions relative to the present sickness problem are: Prevention through public health institutions; cash benefits for wage earners when earnings are interrupted by sickness or by unemployment; and organized medical care of persons in the low-income group. The funds required should be contributed by the subscriber, the employer, and the government.—A. L. C.

A Century of Book Publishing, 1838–1938, Historical and Personal. By John Barnes Pratt. New York, A. S. Barnes and Company, 1938. 56 pp., portraits, illus.

A publishing house that has successfully existed a hundred years has certainly made a record and a name. We extend our warmest congratulations to A. S. Barnes and Company on its centennial in book publishing.

The book under review is a fascinating account of the growth and development of this publishing house under two persons—the founder, Alfred S. Barnes, and the present head, John Barnes Pratt, his nephew. During the pioneer period, "the young publisher had many difficulties to face and overcome, but his early training in what would be termed in these days a 'puritanical household' stood him in good stead, and his clear vision, his unbounded energy and above all his determination to publish only the best books, won for him and his company a high place in the esteem of the educators of that day, and prepared the way for larger usefulness in his chosen career."

Established in 1838, the original and main purpose of A. S. Barnes and Company was to publish a series of educational and textbooks that should excel in all essentials those then in use. The compilation and publication of a new series of high-grade hymnals for churches and schools was added later. In recent years there has also been added what is now recognized as probably the most attractive and authoritative line of books on health, physical education, recreation and sports, and allied subjects.—P. S. S.

Bombyliidæ of Palestine. By E. E. Austin. With seventy-two text figures, a frontispiece, a map by A. J. Engel Terzi, and three photographic plates. London, British Museum (Natural History), 1937. 188 pp., illus. Price, 15s.

This book is a notable contribution to the knowledge of the characteristic bombyliid fauna of Palestine, based on the bulk of the collections formed by the author and on other collections pre-

sented to the British Museum of Natural History by the Imperial Institute of Entomology.

This book is divided into two parts. Part one is an introductory by the author; part 2, which occupies a greater portion of the text, deals largely with the systematic account. The number of Bombyliidæ recorded in this volume is considered remarkable for the small size of Palestine, although the study of this family in Palestine is still far from complete. Species and varieties dealth with number 128, of which 46 are new. The genus *Lissomerus* is described as new. Notes on the nature, coloration, and economic importance of Palestine Bombyliidæ are also included, besides keys to the subfamilies, genera, and species of Bombyliidæ Homœophthalmæ and Bombyliidæ Tomophthalmæ.

The book is supplemented with a frontispiece, 72 text figures, 3 photographic plates, and a map, which are listed on three pages. This part of the book, together with the keys and descriptions, facilitates the identification of the Palestine Bombyliidæ.

An appendix is included, representing the 10 additional species of Bombyliidæ which probably occur in Palestine. The last six pages of the book are devoted to an index.—S. R. C.

Great Barrier Reef Expedition, 1928–29. Scientific Reports, Vols. 1 to 4, 40 nos. London, British Museum (Natural History), 1930–34. Price, ₱100.

These monographs are comprehensive and varied. Ecology, biology, and physiology of invertebrates are well treated. In addition, invertebrate systematics, ichthyology, planktology, and hydrography studies are also included. These works will be very useful in connection with our researches in marine biology, oceanography, and similar studies.—H. A. R.

New Faces—New Futures; Rebuilding Character with Plastic Surgery. By Maxwell Maltz. New York, Richard R. Smith, 1936. 315 pp., illus. Price, $3.

According to the author, this book is the "story of plastic surgery from its crude beginnings twenty-five hundred years ago to its scientific precision of today that is presented in these pages. Effort has been made not only to describe its gradual growth but also to make clear the wide range of its present possibilities . . . True, the real plastic surgeon remodels features, reconstructs faces, but he does this in order that the afflicted may look forward to a future of tranquility and happiness."

Some of the important subjects taken up are the face, mouth, nose, wrinkles, skin, birthmarks and other blemishes, hair, breasts, and other disfigurements. The author has used to great advantage pictures "before and after" to supplement and make clear his discussions.

In writing his introduction of the book, Dr. Alfred Adler says, "I highly recommend this work to the medical profession and to the general reader who is interested in the welfare of his fellow men."—P. S. S.

Sculpture in the Living; Rebuilding the Face and Form by Plastic Surgery. By Jacques W. Maliniak. With a Foreword by Wendell C. Philips. New York., Romaine Pierson, Publishers, 1934. 203 pp., illus. Price, $3.

Plastic surgery is still a new branch of surgery. Dr. Maliniak deplores the misrepresentations given to this important branch of surgery, and bitterly condemns the attitude of the average layman that "the plastic surgeon is still a 'beauty doctor'; for the public has been educated—and usually miseducated—exclusively in the cosmetic aspects of this type of work." He also laments the fact that "some, even in the medical profession, do not understand its applicability to various situations." The task of the author, then, is to present "an authoritative book on surgical reconstruction, defining its nature and scope and explaining its limitations as well as its successes."

The author develops his subject first from the historical side, giving account of the rapid growth and development of plastic surgery during the World War. Then, chapter by chapter, he takes up skin, nose, lips, breast, eyes, ears, face, and disfigurements and other deformities. The book has covered chiefly the social and esthetic aspects of deformities, principally those of the face. The psychic and legal aspects of facial deformities are well covered, making the book very useful not only to physicians but also to medical students, jurists, and others who are interested in the scope and limitations of plastic surgery as well as what it can accomplish at the hands of experienced plastic surgeons.—P. S. S.

A summary of Legislation Relating to the Introduction of Plants into the Colonial Dependencies of the British Empire as at the End of December 1936. London, His Majesty's Stationery Office, 1937. 65 pp. Price, paper, $0.35.

This bulletin is an instructive and informative guide to those engaged in the introduction of seed and plant materials from foreign countries, as well as to those in the plant quarantine

service of the British Government. The bulletin is a compilation of all legislative measures and ordinances adopted by the goverments of the different British Colonies since 1876. It deals in detail with seed and plant materials that are completely denied entry into different dependencies of the British Empire, as well as with those materials that may enter therein under restricted conditions. These legislative measures are calculated to protect British Colonial crop industries from foreign pests and diseases.

In this connection the bulletin likewise itemizes a long list of seed and plant materials that can be admitted to different dependencies of the British Empire under Government Plant Inspection Certificates and other specified requirements.—H. S. S.

Kama Sutra: The Hindu Science of Love. By Mallinaga Vatsyayana. Translated from the Sanskrit by Sir Richard Burton. "The Doctor as Marriage Advisor," by Max Hodan. Introduction by Hanns Heinz Ewers. New York, The Medical Press of New York, 1936. 127 pp. Price, $2.

This little book belongs to the class of contraband literature published with the transparent excuse of promoting harmony in marital relations. Highly discriminating medical men as marriage advisors will find the book interesting. This book will be most useful to advanced students of anthropology and ethnology.—P. S. S.

The Machinery of the Body. By Anton J. Carlston and Victor Johnson. Chicago, University of Chicago Press, c1937. 580 pp., illus. Price, $4.

Physiology has been considered a difficult subject, but with the aid of a textbook like the one under review the study of human physiology is made much more attractive, easy, and comprehensible. In this book the activities of the different departments and units of the human machine are clearly described and compared with those of other animals.

Following the practice in teaching elementary science in the university of Chicago where the authors are teaching, the illustrations used in this book have been taken from some of the films of the biology series. The authors are to be congratulated for being able to produce a most valuable textbook embodying their painstaking researches on the subject.—M. B.

Man in a Chemical World; the Service of the Chemical Industry. By A. Cressy Morrison. New York, Charles Scribner's Sons, 1937. 292 pp., illus. Price, $3.

In 1935 the American Chemical Society celebrated the tercentenary of the founding of chemical industries in America,

with the largest chemical meeting ever held. It pointed with pride to a record of achievement which few other American industries can match.

In order to commemorate this anniversary the Tercentenary Committee decided to have a book published to impress the man in the street with the fact that the chemical industries in the United States render a service that touches practically every activity in which he engages.

The expectations of the Committee were fully realized. For this book emphasizes the fact that chemical research has been very helpful in developing numerous familiar industrial products. Many topics, such as foods, water purification, anæsthetics, fertilizers, airplanes, rayon underwear, plastics, paper, leather, lacquer paints, new alloys, synthetic rubber, and others, are discussed from a popular chemical point of view.

Especially interesting is L'Envoi, in which the author traces the manufacture of the book as follows:

The glimpses of chemical industry's service to man afforded by this book could be presented only by utilizing innumerable chemical products. The first outline of its plan began to take shape on chemically produced note paper with the aid of a piece of chemically treated graphite held in a synthetic resin pencil. Early corrections were made with erasers of chemically compounded rubber. In its ultimate haven on the shelves of your bookcase, it will rest on a coating of chemical varnish behind a pane of chemically produced glass. Nowhere has it been separated from that industry's products.

The manuscript was typed on a modern typewriter composed principally of metallic alloys. Pressure on its keys of synthetic resin forced alloy type faces against a textile ribbon which left impressions in synthetic dye on paper supported by a chemically compounded rubber roller. Later, the entire typescript was reproduced in manifold through the chemical process of photolithography for review by many persons.

Ultimately, the type from which the book was printed was cast in alloy metal, corrected and finally electrotyped by a process involving numerous other chemical products and reactions. Impressions from this type were made with ink consisting of carbon black (recovered from natural gas) in a varnish chemically prepared. The ink was spread upon the type by rolls of gelatin chemically compounded with glycerine and transferred to paper chemically made from spruce trees.

The artists prepared drawings with inks of a different character, but of similar chemical origin, and these originals were reproduced by photochemical engraving to form plates adapted to the purposes of the printer.

The printed sheets, after assembly, were stitched with chemically treated thread, glued with chemical adhesives and bound between pulp boards, chemical products of the forest, decorated and protected by cloth heavily sized with a chemical mixture.—A. P. W.

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STUDIES ON PHILIPPINE ORCHIDS, I

By EDUARDO QUISUMBING

Curator, Philippine National Herbarium, Bureau of Science, Manila

SEVEN PLATES

The present contribution is the result of further studies of those orchids in the Philippines that appear to deserve recognition as being new or interesting. One genus (*Poaephyllum*) and two species (*Dendrobium macrophyllum* and *Dendrobium quadrisulcatum*), which have been described previously, are for the first time credited to the Philippines with certainty. *Dendrobium ternatense* is redescribed here. Four species are here proposed as new. All illustrations and descriptions have been prepared from living specimens, except the description of *Poaephyllum grandiflorum* and *Dendrochilum Edanoi* which are based on herbarium specimens. The colored illustrations were made by Mr. Pedro Ramos and the ink sketches by Messrs. V. V. Marasigan and R. C. Aguilar, all of the National Museum, Bureau of Science. Unless otherwise indicated in the text, the types of the new species have been deposited in the Philippine National Herbarium, Bureau of Science, Manila.

Genus DENDROCHILUM Blume

DENDROCHILUM EDANOI Quisumbing sp. nov.

Aff. *D. Clemensiæ* Ames. Pseudobulbi fusiformes, 3 ad 4 cm longi; vaginae elongatae, tubulares. Folium cum petiolo 12.5 ad 15.7 cm longum; lamina 11 ad 14 cm longa, 2.8 ad 3.3 cm lata, oblongo-lanceolata, acuta, in sicco chartacea, 7-nervia. Pedunculus gracilis, 3 ad 4 cm longus. Inflorescentia cum

pedunculo 17.5 ad 34.5 cm longa. Flores 24 ad 65, distichi, 4 ad 5 mm distantes. Bracteae 3 ad 4 mm longae, ovatae, acutae. Sepala lateralia oblongo-lanceolata, acuta, 6.75 ad 7 mm longa, 2 ad 2.25 mm lata, 3-nervia. Sepalum dorsale oblongo-lanceolatum, 6.5 ad 6.75 mm longum, circiter 2 mm latum, acutum. Petala anguste oblongo-lanceolata, acuta, circiter 6.5 mm longa, 1.5 mm lata, 3-nervia. Labellum 3-lobatum, circiter 6 mm longum; lobi laterales parvi, angustæ triangulares, acuminati; lobus medius subrotundatus, obtusus, circiter 3 mm longus, 2 mm latus; discus inferne cum 2 lamellis. Columna gracilis; alae laterales oblique truncatae, circiter 2 mm longae; lobus terminalis late obtusa et irregulariter minute denticulata.

Pseudobulbs fusiform, 3 to 4 cm long; sheath elongate, tubular. Leaves with petioles, 12.5 to 15.7 cm long; lamina oblong-lanceolate, acute, 11 to 14 cm long, 2.8 to 3.3 cm wide, chartaceous when dry, 7-nerved. Peduncle very slender, 3 to 4 cm long. Flowers white, 24 to 65, distichous, 4 to 5 mm distant. Bracts 3 to 4 mm long, ovate, acute. Lateral sepals oblong-lanceolate, acute, 6.75 to 7 mm long, 2 to 2.25 mm wide, 3-nerved. Dorsal sepal similar in shape to lateral sepals, 6.5 to 6.75 mm long, about 2 mm wide, 3-nerved. Petals narrowly oblong-lanceolate, acute, about 6.5 mm long, 1.5 mm wide, 3-nerved. Labellum 3-lobed, about 6 mm long; lateral lobes small, narrowly triangular, acuminate; middle lobe when expanded subrotund, obtuse, about 3 mm long, 2 mm broad, disc with 2 long lamellæ. Column elongate, slender, lateral wings simple, obliquely truncate, about 2 mm long, on the species I examined about 2 mm long; upper lobe elongate, broadly obtuse and minutely denticulate or erose.

PALAWAN, Mount Gantung, *Bur. Sci. 77914 G. Edaño*, May 8, 1929.

Dendrochilum Edanoi is allied to *D. Clemensiæ* Ames, but differs from the latter in having a shorter column and especially in the obtuse terminal lobe. *D. papillosum* J. J. Sm. is apparently allied to the present species, but differs from it in having broader sepals and petals and a dissimilar midlobe of lip. *D. tardum* J. J. Sm. has a longer peduncle, a shorter raceme, an acute midlobe of lip, and acuminate column arms which are simple at the tip.

This species is named in honor of Mr. Gregorio Edaño, for almost three decades a botanical collector of the Philippine National Herbarium, Bureau of Science.

Genus DENDROBIUM Swartz

DENDROBIUM (subg. **PEDILONUM**) **GONZALESII** Quisumbing sp. nov. Plate 1, figs. 5 to 8; Plate 2, figs. 1 to 14.

Aff. *D. victoriæ-reginæ* Loher. Caules fasciculati, penduli, parce ramosi, 40 ad 55 cm longi, foliosi; internodia cylindracea, 1 ad 1.5 cm longa, fibrillis vaginarum macrescentium vestita. Folia oblongo-lanceolata vel lanceolata, acuta, 5 ad 9.5 cm longa, 1.2 ad 1.8 cm lata, nervosa, papyracea. Racemi pauciflori (1- ad 3-flori); bracteæ parvæ, membranaceæ, oblongæ, acutæ, 5 ad 6 mm longæ. Sepala lateralia lineari-lanceolata, acuta, 2.5 ad 2.6 cm longa, circiter 6 mm lata, 5-nervia, mentum curvatum cylindraceum formantia. Sepalum dorsale anguste oblongum, acutum, 2.2 ad 2.3 cm longum, circiter 5 mm latum, 5-nervum. Petala anguste oblonga, acuta, 2.4 ad 2.5 cm longa, 4.5 ad 5 mm lata, 5-nervia. Labellum simplex, anguste oblongum, acutum, 2.8 ad 2.9 cm longum, 7 ad 8 mm latum, 7-nervium, laeve. Gynostemium perbreve, carnosum, circiter 3 mm longum, in pedem extensum; stelidia erecta, lateralia obtusa, stelidium medium subulatum.

Habit of *D. chameleon* Ames and *D. victoriæ-reginæ* Loher. Stems fascicled, slender, pendulous, 40 to 55 cm long; branches few, jointed, nodes swollen, internodes 1 to 1.5 cm long. Leaves oblong-lanceolate, or lanceolate, acute, 5 to 9.5 cm long, 1.2 to 1.8 cm wide, papyraceous, nervose when dry. Racemes few-flowered (1- to 3-flowered); bracts oblong, acute, 5 to 6 mm long, membranaceous. Flowers odorless, showy; pedicellate ovary slender. Lateral sepals linear-lanceolate, acute, 2.5 to 2.6 cm long, about 6 mm wide, 5-nerved, forming a conspicuous slender, cylindrical curved mentum, when stretched out 1.4 to 1.5 cm long. Dorsal sepal narrowly oblong, acute, 2.2 to 2.3 cm long, about 5 mm wide, 5-nerved. Petals narrowly oblong, acute, 2.4 to 2.5 cm long, 4.5 to 5 mm wide, 5-nerved. Labellum simple, narrowly oblong, acute, 2.8 to 2.9 cm long, 7 to 8 mm wide, 7-nerved, flat, devoid of any raised lines or calli. Column very short, stout, fleshy, about 3 mm long; lateral arms erect, obtuse, middle one subulate.

LUZON, Manila, Mrs. Remedios C. Gonzales' garden, *Phil. Nat. Herb. 3451 Eduardo Quisumbing*, September 12, 1935. Plants were originally collected by Mr. and Mrs. Jose Salvador Gonzales from Mayon Volcano, Albay Province, Luzon, at an altitude of about 860 meters, growing on tree trunks. Sepals and petals

white, edged with pale amaranth pink; lip white; lined at the base with aster purple, and edged with faint glass green except the tip; spur white, tipped with glass green; column white.

A species closely allied to *Dendrobium victoriæ-reginæ* Loher, differing in its curved spur and in its narrowly oblong labellum.

The species is dedicated to Mr. Jose Salvador Gonzales, Assistant Chief Engineer of the City of Manila, and a lover of orchids.

Another plant, *Phil. Nat. Herb. 3452 Eduardo Quisumbing*, September 12, 1935, found growing on the same tree as the species, must be referred to this species. It differs in its mauve and larger flowers and the obovate labellum.

DENDROBIUM MACROPHYLLUM A. Richard. Plate 1, figs. 3 and 4; Plate 3, figs. 1 to 11; Plate 7. figs. 1 and 2.

Dendrobium macrophyllum A. RICH., Sert. Astrol. (1834) 22, *t. 9;* REICHB. F. in Walp. Ann. 6 (1861) 304; Illustr. Hortic. 35 (1888) 59, *t. 57;* WILL., Orch. Album 8 (1889) *t. 339*, Orch. Grow. Man. ed. 7 (1894) 349; J. J. SM., Fl. Buitenz. 6 (Orch.-Jav.) (1905) 347; Orch. Ambon. (1905) 55; AMES, Orch. 2 (1908) 179; KRÄNZL. in Eng. Pflanzenreich IV 50 II 21 (1910) 244, *fig. 20. D-E;* SCHLTR., Die Orchideen (1927) 263.

Dendrobium Veitchianum LINDL., Bot. Reg. (1847) sub. *t. 25;* DE VRIESE, Illustr. Orch. Ind. Neerl. (1852) *t. 5 et t. 18 fig. 3;* PAXT., Mag. Bot. 14 (1847) 115; REICHB. F. in Walp. Ann. 1 (1849) 778, in Bonpl. 5 (1857) 56; MIQ., Fl. Ind. Bat. 3 (1859) 632; MÜLLER, Desc. Notes Pap. Plts. 30.

Dendrobium macrophyllum A. Rich var. *Veitchianum* HOOK. F. in Bot. Mag. (1867) *t. 5649;* WILLIAMS, Orch. Grow. Man. ed. 7 (1891) 349; SANDER, Orch. Guide (1927) 180; VEITCH, Man. Orch. Pl. pt. 3 (1888) 60.

Dendrobium ferox HASSK., Retzia 1 (1885) 1.

Dendrobium polysema SCHLTR. in Schum. Lauterb. Nachtr. Fl. Deutsch. Schutzgeb. (1905) 163.

Dendrobium sarcostoma TEIJSM. & BINN., Ms. Ex. Miq. Fl. Ind. Bat. 3 (1859) 637.

Callista Veitchiana O. K., Rev. Gen. Pl. (1891) 655.

The original description reads as follows:

Foliis amplis elliptico-oblongis, acutis, coriaceis, *scapo* simplici; floribus magnis spicatis; *spica* longa interrupta; *pedicellis ovarioque* hispidis, *bractea* persistenti lanceolata glabra longioribus; laciniis externis pilosis; interioribus spathulatis acuminatis; *labello* perfunde trilobo, concavo, basi unguiculato. Nob. *Crescit* in Nova-Guinea.—RICHARD, *loc. cit.*

Stems erect, fascicled, base narrowed, somewhat flattened, deeply grooved, 30 to 42 cm high, 2 to 2.5 cm in diameter, 2- to 3-leafed. Leaves oblong-elliptic, acute, leathery, 22.5 to 25.5

cm long, 4.5 to 7.5 cm wide. Racemes longer than leaves, 35.5 to 44 cm long including peduncles, somewhat nodding at apex, 16- to 18-flowered; peduncles 15.5 to 18 cm long; bracts membranaceous, lanceolate, acute, 2.5 to 3.2 cm long, 1 to 1.3 cm wide when expanded at widest portion, smaller at apex of raceme; pedicellate ovary setigerous, 3 to 4.8 cm long. Flowers somewhat fragrant, 5 to 6 cm across. Lateral sepals falcate, externally setigerous, triangular, lanceolate, acutely acuminate, 2.5 to 2.8 cm long, 9.5 to 10.5 cm wide. Dorsal sepal oblong, externally setigerous, acutely acuminate, 2.7 to 3.2 cm long, 1 to 1.1 mm wide. Spur not conspicuous, 10 to 11 mm long. Petals spathulate, acute, glabrous, 2.5 to 3 cm long, 10 to 11.5 mm wide. Labellum deeply 3-lobed; lateral lobes erect, broadly cuneate, 1.2 to 1.3 cm high, 1.3 to 1.5 cm wide; middle lobe concave, subreniform, apiculate, 1.2 to 1.3 cm long, 2 to 2.2 cm wide when expanded; in the disc in front of the narrow claw a thick, fleshy callus; column short, fleshy, 3 to 4 mm long.

LUZON, Manila, Mrs. Remedios C. Gonzales' garden, *Phil. Nat. Herb. 3452 Eduardo Quisumbing*, March 16, 1936. The plant was purchased in Manila from Mr. W. Parsons, who claimed that it was originally collected in the Mountain Province.

Peduncles kildare green; bracts glass green, base paler; sepals chalcedony yellow with few blackish red-purple dots on the back; petals citron yellow with few blackish purple dots; lateral lobes of lip lumiere green with radiating bordeaux streaks; middle lobe lumiere green with a few radiating lines of blackish red-purple dots; callus white; column lumiere green; anther spinach green.

My material is without doubt *D. macrophyllum* A. Rich. While it is a recently discovered addition to the Flora of the Philippines, it is one of our handsomest species. Borneo, Java, Amboina, Ternate, New Guinea. *Dendrobium macrophyllum* differs from *D. ternatense* J. J. Sm. in its much larger stems, larger flowers, and in other floral details.

DENDROBIUM QUADRISULCATUM J. J. Sm. Plate 4, figs. 1 to 12.

Dendrobium quadrisulcatum J. J. SM. in Bull. Jard. Bot. Buitenz. XI 25 (1917) 49, Icones Orch. Malay II Suppl. 2 (1934) *t. 85 III.*

The original description reads as follows:

DENDROBIUM (sect. Distichophyllum) QUADRISULCATUM J. J. S. n. sp.

Caules approximati, erecti, plus minusve quadrangulares, inferne teretes, sicco alte 4 sulcati, c. 20–45 cm. longi, dense distiche foliati, internodiis ad

c. 1.8 cm. longis, superioribus ad c. 0.5 cm. reductis. Folia patentia, basi semitorta, oblonga ad oblongo-linearia, oblique obtuse biloba, supra impressione lanceolato-ovato-triangula notata, coriacea, c. 2-4.5 cm. longa, 0.55–1 cm. lata; vaginae tubulosae, internodia superantes. Inflorescentiae ad nodos caulium, 2 vaginas perforantes, 1 florae, pedunculo brevissimo, non nullis vaginulis acutis donato. Flores minusculi. Sepalum dorsale reflexum, ovato-triangulum, acuminatum, acutum, convexum, c. 0.83 cm. longum, 0.44 cm. latum. Sepala lateralia lacinia oblique triangulare ad pedem gynostemii decurrentia, mentum conicum obtusum c. 0.7 cm. longum formantia, reflexa ad recurva, parte antica oblique oblongo-triangula, acuminata, acuta, convexa, c. 0.9 cm. longa, basi 1 cm. lata. Petala oblique reflexa, oblique ovata, supra medium contracta, acuminata, acuta, convexa, basi 3-nervia, c. 0.9 cm. longa, 0.46 cm. lata. Labellum basi longitudine c. 0.55 cm. pedi gynostemii adnatum, e basi cuneata valde dilatatum, 3 lobum, crasse carnosum, intus costis 2 longitudinalibus crasse carnosis subverruculosis intermedii, apice costula tertia brevi alta rotundato-lamelliformi interposita, explanatum totum c. 1.9 cm. longum, ad lobos laterales 2 cm. latum, ungue c. 0.5 cm longo; lobi laterales subpatentissimi, oblique oblongi, obtusissimi, convexi, c. 0.6 cm. longi, medio 0.4 cm. lati; lobus intermedius magnus, late transverse suboblongus, utrinque obtusus, apice latissime rotundatus medio retusus, marginibus lateralibus recurvis, crassus c. 0.9 cm. longus, 1.73 cm. latus. Gynostemium c. 0.46 cm. longum, auriculis obtusissimis, quam antheram brevioribus. Anthera cucculata, dorso impressa, apice truncata et puberula. Pes gynostemii c. 0.75 cm. longus. Ovarium c. 0.6 cm. longum; pedicellus c. 1.2 cm. longus.

Borneo; Goenoeng Damoes. (H. Hallier 1893, n. 563, type). Goenoeng Kenepai. (H. Hallier 1893, n. 2450). Amai Ambit. (H. Hallier 1894, n. 3425).

This belongs to a small group of species of the section Distichophyllum with a deeply divided labellum, narrow side lobes and a broad midlobe, as f. e. *D. xanthophaeum* Schltr. from New-Guinea and *D. kenepaiense* J. J. Sm. In the form of the keels on the lip it much resembles *D. xanthophaeum*, but has ovate acute petals and very blunt side lobes of the lip.

Description from herbarium specimens.

In habit similar to the closely allied *D. uniflorum* Griff. Stems erect, foliose, more or less 4-angled, basal portion terete and smaller, 25 to 35 cm long, sheaths distinctly ridged; internodes 1.5 to 2 cm long, upper internodes reduced. Leaves linear-lanceolate, unequally bilobed at the narrowed apex, subcoriaceous, 3 to 7 cm long, 4 to 6 mm wide. Inflorescence 1-flowered, appearing at nodes; peduncles very short. Lateral sepals obliquely triangular-ovate, shortly acuminate, acute, 1 to 1.1 cm long, 6.5 to 6.8 mm wide, 5-nerved; spurlike mentum conical, obtuse, slightly recurved. Dorsal sepal reflexed, triangular-ovate, shortly acuminate, acute, about 1 cm long, 6 to 7 mm wide, 5-nerved. Petals obliquely reflexed, narrowly oblong-lanceolate, acute, about 1 cm long, 3.3 mm wide, 3-nerved. Labellum 3-

lobed, about 1.6 cm long; lateral lobes obliquely oblong, obtuse, about 8 mm long; middle lobe broad, subquadrate when expanded, broadly obtuse or retuse, sides recurved, about 1 cm long, 1.6 cm wide. Column thick, fleshy, about 6 mm long, with short obtuse auricles.

MINDANAO, Zamboanga Province, Zamboanga, *Phil. Nat. Herb. 3453 Mrs. K. B. Day*, June 24, 1935, flowers yellowish.

Our specimen matched well with the species, differing slightly in having longer and narrower leaves and in its narrower petals.

DENDROBIUM TERNATENSE J. J. Sm. Plate 1, figs. 1 and 2; Plate 3, figs. 12 to 21; Plate 6, figs. 1 and 2.

Dendrobium ternatense J. J. SM. in Bull. Dept. Agr. Ind. Neerl. 22 (1909) 25; KRÄNZL. in Engl. Pflanzenreich IV 50 II B 21 (1910) 246, *fig. 20 A-C;* AMES, Orch. 5 (1915) 139; in Merr. Enum. Philip. Fl. Pl. 1 (1924) 356.

Dendrobium macrophyllum A. RICHARD acc. to Ames Orch. 2 (1908) 179; KRÄNZL. in Engl. Pflanzenreich IV 50 II B 21 (1910) 244, quoad Philip.

The original description reads as follows:

Caules approximati, elongati, clavati, 2/5 partibus inferioribus tenues, superne incrassati, apicem versus attenuati, sectione transverse elliptici, 4–5 nodes, internodio ultimo maximo, profunde sulcati, olivacei, adulti atrofusci, ad c. 18 cm. long., 1.75 cm. lati, initio vaginis magnis tubulosis tecti, apice 2-folii. Folia e basi erecta divaricata, oblonga, apice acute bidentata, costa media supra sulcata, subtus prominente, coriacea, supra nitide viridia, subtus opaca pallidiora, c. 15 cm. longa, 4.5-5 cm. lata. Inflorescentiae pseudo-terminales, laxe pauciflorae. Bracteae ovatae, acutae, valde concavae, glabrae, dilute flavo-virides, c. 1.5 cm. longae, 1.35 cm. latae. Flores majusculi, c. 3-3.7 cm. diam., sepalis dorso carnoso-pilosis petalisque dilute viridiflavis, dorso minute sordide violaceo-maculatis, deinde aureis. Sepalum dorsale ovato-triangulum, acuminatum, acutum, conico-apiculatum, concavum, 5-nervium, c. 1.85 cm. longum, fere 1 cm. latum. Sepala lateralia cum pede gynostemii mentum breve, rectum, obtussissimum formantia, oblique triangula, longium subulato-acuminata, 5-nervia, c. 2 cm. longa, 1.15 cm. lata. Petala leviter curvata, marginibus inferne recurvis, superne incurvis, unguiculata, oblongo-elliptica, acuminata, acuta, 3-nervia, c. 175 cm. longa, ungue c. 0.27 cm. lato, lamina c. 1.35 cm. longa, 0.575 cm. lata. Labellum breviter unguiculatum, 3-lobum, carnosum, inter lobos laterales callo longitudinali, breviusculo, rectangule oblongo, 3-costato, antice 3-lobulato, postice in lamellam bilobam dilatato, edentato, sulcato et marginibus posticis loborum lateralium basi tantum adnato, niveo donatum, expansum totum c. 1.6 cm. longum, ad lobos laterales 2.7 cm. latum, ungue concavo, dilute viridi, lobis lateralibus erectis, incurvis, oblique oblongis, apicem versus paulo angustatis, truncatis, margine postico subrectis, antice irregulariter marginatis, convexis, pallide viridibus, margine antico albescentibus, dilute plumbeo-striatis, c. 1 cm. longis, 0.5 cm. latis, lobo intermedio magno laxe undulato, apice decurvo, transverse subovali, dilute flavo-viridi,

striis ramosis punctorum plumbeorum ornato, c. 1.1 cm. longo, 1.9 cm. lato. Gynostemium brevissimum, album, subtus purpureo-punctatum, c. 0.3 cm. longum, auriculis incurvis, triangulis, obtusis. Anthera cucullata, antice plana, apice truncata, viridis, apice alba. Pes gynostemii cum ovario angulum obtusum faciens, rectus, apicem versus angustatus, truncatus, purpureo-punctatus, apice concavus et viridis, c. 8 cm. longus. Ovarium cranosulo-pilosum, pallide viride, c. 0.4 cm. longum, cum pedicello piloso pallide viridi-flavo c. 2 cm. longo angulum obtusum faciens.

Ternate: Auf dem Piek (J. J. S. 1900, n. 325 m. leb. Pfl.)

Von dem nächstverwandten *D. macrophyllum* A. Rich. ist diese Art durch kleinere Dimensionen, die Farbe, schmale Seitenlappen der Lippe und den am Grunde kaum mit den hinteren Rändern der Seitenlappen zusammenhängenden Callus verschieden.

Die Beschreibung wurde nach einer in Buitenzorg kultivierten Pflanze angefertigt.

Stems slender, erect, about 20 to 25 cm long, narrowly clavate with 4 to 6 nodes up to 2 cm in diameter at the thickest portion, diphyllous, when immature amply clothed with inflated, scarious sheaths which are imbricating and 2 to 8 cm long, uppermost node largest and grooved. Leaves oblong-elliptic, acute, 8 to 17.5 cm long, 4.2 to 6.1 cm wide. Floral bracts ovate-triangular, acute, much shorter than setigerous pedicels which are 2 cm long. Racemes short, about 10 cm long, laxly 6- to 7-flowered. Flowers 3.5 to 3.7 cm across. Lateral sepals triangular-ovate, acutely acuminate, carinate, externally setigerous, 20 to 22 mm long, about 10 mm wide, forming a very short spurlike mentum. Dorsal sepal similar to lateral sepals. Petals slightly curved, oblong-elliptic, acutely acuminate, glabrous, 15 to 18 mm long, about 6 mm wide. Labellum fleshy, 3-lobed, lobes subequal; lateral lobes erect, incurved, broadly cuneate, 15 to 16 mm long, 9 to 11 mm wide, apex truncate; middle lobe transversely oval, apiculate, 9 to 10 mm long, 16 to 17 mm wide; on the disc in front of the narrow claw a 3-lobed, erect, callus. Gynostemium very short, white, about 3 mm long.

Epiphyte; flowers slightly odorous; sepals baryta yellow; petals straw-yellow; front lobe of lip chalcedony yellow, lateral lobes pale pink with walnut brown and shade of purple, dotted at base on outside with deep corinthian red; callus ivory yellow; column white, dotted at base with liserian purple; pollinia olive yellow.

The species was originally known from Ternate. Its first Philippine representative, *H. N. Whitford No. 1083*, was collected in February 13, 1905, from Mount Mariveles, Bataan

Province, at an altitude of 900 meters. The other specimen was collected by H. Costenoble from Perak, Pampanga Province, Luzon, September 8, 1930 (*Phil. Nat. Herb. 3454 H. Costenoble*). Also coll. Loher, Rizal Province, September, 1909, *14592, 14593, 14702.*

Genus ERIA Lindley

ERIA ALICIAE Quisumbing sp. nov. Plate 5, figs. 1 to 12.

Habitu *E. longissimæ* Ames & Quis. similis. Caules validi caespitosi, simplices, basi teretes, superne leviter complanati, foliosi, 90 ad 155 cm longi, 8 ad 12 mm in diametro; internodia 2.5 ad 3.5 cm longa. Folia lineari-lanceolata, attenuata, acuta, 10 ad 19.4 cm longa, 1 ad 1.7 cm lata, glabra, in sicco subcoriacea, basi vaginantia. Inflorescentiae oppositifoliae saepissime, 3-florae; pedunculos usque ad racemum brevis; bracteae 3, conspicuae, glabrae, lanceolatae, acutae, 1.7 ad 2.6 cm longae, 2.5 ad 7 mm latae, in basi cordatae. Flores circiter 1 cm longi; pedicellus cum ovario glaber, 17 ad 18.5 mm longus. Sepala lateralia subfalcata, oblongo-ovata, obtusa, 16.5 ad 17 mm longa, 7 ad 8 mm lata, apici leviter carnosa, 7-nervia, mentum brevem obtusum formantia. Sepalum dorsale leviter cucullatum, oblongo-ovale, obtusum, 17 ad 18 mm longum, 7 ad 8 mm latum, 7-nervium. Petala leviter obliqua, oblongo-ovalia, obtusa, 13 ad 14 mm longa, 6 ad 7.5 mm lata, 5-nervia. Labellum sessile, in circuitu oblongo-ovatum simplex, apice rotundatum, circiter 1.3 cm longum; dencissime pubescens, prasertime in margine. Gynostemium 6 ad 6.5 mm longum.

An epiphyte with much the habit of *Eria longissima* Ames & Quis. Stems simple, stout, cæspitose, terete at the base, somewhat flattened above, drooping in habit, foliose, 90 to 155 cm long, 8 to 12 mm in diameter; internodes 2.5 to 3.5 cm long. Leaves linear-lanceolate, 10 to 19.4 cm long, 1 to 1.7 cm wide, gradually narrowed to the acute apex, glabrous, somewhat firm in living condition, subcoriaceous when dry, nervose, light green, base clasping, sheathed. Racemes very short compared with plant, opposite leaves, several-flowered; peduncles very short, not more than 5 mm long; bracts citron-yellow, conspicuous, glabrous, lanceolate, acute, 1.7 to 2.6 cm long, 2.5 to 7 mm broad. Flowers odorless, white, with a tinge of pink at base of the sepals and petals, about 1.5 cm long; pedicellate ovary glabrous, 17 to 18.5 mm long. Lateral sepals subfalcate, oblong-ovate, obtuse, 16.5 to 17 mm long, 7 to 8 mm wide, the very tip fleshy, 7-nerved,

forming a very short, obtuse mentum. Dorsal sepal slightly cucullate, oblong-oval, obtuse, 17 to 18 mm long, 7 to 8 mm wide, 7-nerved. Petals slightly oblique, oblong-oval, obtuse, 13 to 14 mm long, 6 to 7.5 mm broad, 5-nerved. Labellum sessile, whitish, cream with orange margins, oblong-ovate, ciliate, entire, about 1.3 cm long. Disc very densely and finely pubescent, without keels. Gynostemium 6 to 6.5 mm long.

LUZON, Benguet Subprovince, Baguio, altitude, 5,000 feet. Mrs. Colton's gardens, *Phil. Nat. Herb. 3455 Mrs. A. W. Day,* May, 1934. The living plants, which are being cultivated in the gardens of Mrs. Colton in Baguio, have been collected by Igorot peddlers from mountains in the vicinity of Baguio.

Eria Aliciæ is a near relative of *Eria longissima* Ames & Quis., from which it is readily distinguished by floral characters, notably by having broader sepals and petals and a simple lip.

Genus POAEPHYLLUM Ridley

POAEPHYLLUM GRANDIFLORUM Quisumbing sp. nov.

Caules complanati, circiter 65 cm alti. Folia linearia apice, obtuso minute bilobata, 5 ad 6.5 cm longa, 5 ad 7.5 mm lata. Racemi pauciflori, axillares, breves, 1.5 ad 2 cm longi. Flores albi. Sepala lateralia triangulari-lanceolata, acuminata, acuta, carinata, basi connata, mentum breve formantia, circiter 6.5 mm longa, 3 mm lata. Sepalum dorsale lineari-oblongum, acutum, circiter 5.5 mm longum, 2 mm latum, 1-nervium. Petala linearia, obtusa, circiter 5 mm longa, 1.5 mm lata, 1-nervia. Labellum circiter 6 mm longum, 4 mm latum, spathulatum, canaliculatum, apice subrotundatum, obtusum, linea incrassata carnosa in disco praeditum. Columna brevis, crassa; stelidia brevia, subulata, obtusa, erecta, circiter 0.05 mm longa. Pollinia 8.

Epiphyte, habit of *Agrostophyllum.* Stems slender, entirely concealed by leaf sheaths, flattened, leafy, about 65 cm high, about 5 mm wide, basal portion somewhat terete. Leaves distichous, linear, obtuse, minutely bilobed at apex, 5 to 6.5 cm long, 5 to 7.5 mm wide, about 1 cm distant; sheaths persistent. Racemes axillary, few-flowered, 1.5 to 2 cm long; peduncles very slender, rachis fractiflex. Flowers rather large for this genus, white; bracts minute, triangular-lanceolate, acute, 1.5 to 2 mm long. Lateral sepals triangular-lanceolate, acuminate, acute, carinate, base adnate to foot of column, about 6.5 mm long, 3 mm wide. Dorsal sepal linear-oblong, acute, about 5.5 mm long, 2 mm wide, 1-nerved. Petals linear, obtuse, about 5 mm long, 1.5 mm wide, 1-nerved. Labellum about 6 mm long,

4 mm wide at apex when expanded, spathulate, canaliculate, apex subrounded, obtuse, fleshy disc in center; anterior part of labellum concave, with erose margins. Column short, fleshy; stelidia very short, subulate, obtuse, erect, about 0.05 mm long. Pollinia 8, four appearing definitely smaller than remaining four.

PALAWAN, Mount Manalsal, *Bur. Sci. 77916 G. Edaño,* May 14, 1929, summit, altitude about 1,000 meters.

Vegetatively this plant appears to be a good match for *P. parviflorum* (J. J. Sm.) Ridl. (*Lectandra parviflora* J. J. Sm.). The presence of 8 pollinia and the central longitudinal thickening of the lip mark the plant as a representative of the genus *Poaephyllum.* But the single flower present is much larger than any in the genus, and the anterior part of the lip is concave with erose margins. Also, four of the pollinia appear definitely smaller than the other four.

ILLUSTRATIONS

[Plate 1 was prepared by Pedro Ramos; Plates 2 to 5 by V. V. **Marasigan** and **R.** C. Aguilar; Plates 6 and 7 were taken by the photographic section of the Bureau of Science.]

PLATE 1

FIG. 1. *Dendrobium ternatense* J. J. Sm., front view of flower, × 1.
2. *Dendrobium ternatense* J. J. Sm., side view of flower, × 1.
3. *Dendrobium macrophyllum* A. Rich., front view of flower, × 1.
4. *Dendrobium macrophyllum* A. Rich., side view of flower, × 1.
5. *Dendrobium Gonzalesii* Quis. sp. nov., front view of flower, × 1. (Type, *Phil. Nat. Herb. 3451 Eduardo Quisumbing.*)
6. *Dendrobium Gonzalesii* Quis. sp. nov., side view of flower, × 1. (Type, *Phil. Nat. Herb. 3451 Eduardo Quisumbing.*)
7. *Dendrobium Gonzalesii* Quis. sp. nov., front view of flower, × 1. (*Phil. Nat. Herb. 3452 Eduardo Quisumbing.*)
8. *Dendrobium Gonzalesii* Quis. sp. nov., side view of flower, × 1. (*Phil. Nat. Herb. 3452 Eduardo Quisumbing.*)

PLATE 2

Dendrobium Gonzalesii Quis. sp. nov., type. *1*, Habit, one-third natural size; *2*, dorsal sepal, × 1 (circa); *3*, petal, × 1 (circa); *4*, lateral sepal, × 1 (circa); *5*, column, spur, and labellum from above, × 1 (circa); *6*, front view of flower, × 1 (circa); *7*, side view of flower, × 1 (circa); *8*, front view of column, × 3 (circa); *9*, anther from above, × 7 (circa); *10*, anther from below, × 7 (circa); *11*, pollinia, × 7 (circa). *Phil. Nat. Herb. 3452 Eduardo Quisumbing: 12*, front view of flower, × 1 (circa); *13*, side view of flower, × 1 (circa); *14*, column, spur, and labellum from above, × 1 (circa).

PLATE 3

Dendrobium macrophyllum A. Rich. *1*, Dorsal sepal, × 1; *2*, lateral sepal, × 1; *3*, petal, × 1; *4*, bract, × 1; *5*, front view of column, × 3; *6*, labellum from above (natural position), × 1; *7*, side view of labellum (natural position), × 1; *8*, labellum from above (stretched out), × 1; *9*, anther from above, × 8; *10*, anther from below, × 8; *11*, pollinia, × 8.

Dendrobium ternatense J. J. Sm. *12*, Dorsal sepal, × 1; *13*, lateral sepal, × 1; *14*, petal, × 1; *15*, bract, × 1; *16*, labellum and column from above (natural position), × 1; *17*, side view of ovary, and labellum (natural position), × 1; *18*, labellum from above (stretched out), × 1; *19*, anther from above, × 8; *20*, anther from below, × 8; *21*, pollinia, × 8.

PLATE 4

Dendrobium quadrisulcatum J. J. Sm. *1*, Habit, one-third natural size; *2*, flower, showing labellum, column, sepals, and petals from above (natural position), × 1; *3*, side view of flower showing pedicel, ovary, spur, column, sepals, petals, and labellum (natural position), × 1; *4*, dorsal sepal, × 2; *5*, petal, × 2; *6*, lateral sepal, × 2; *7*, labellum from above (natural position), × 1; *8*, labellum from above (stretched out), × 1; *9*, front view of column, × 2; *10*, anther from above, × 4; *11* anther from below, × 4; *12*, pollinia, × 4.

PLATE 5

Eria Aliciae Quis. sp. nov. *1*, Upper portion of stem, one-fourth natural size; *2*, bract, × 1; *3*, dorsal sepal, × 1; *4*, lateral sepal, × 1; *5*, petal, × 1; *6*, front view of column, and labellum (natural position), × 2; *7*, side view of ovary, column, and labellum (natural position), × 2; *8*, front view of column, × 2; *9*, labellum from above (stretched out), × 2; *10*, anther from above, × 5.5; *11*, anther from below, × 5.5; *12*, pollinia, × 5.5.

PLATE 6

FIG. 1. *Dendrobium ternatense* J. J. Sm. Habit, very much reduced.
2. *Dendrobium ternatense* J. J. Sm. Top of plant with flowers, much reduced.

PLATE 7

FIG. 1. *Dendrobium macrophyllum* A. Rich. Habit; very much reduced.
2. *Dendrobium macrophyllum* A. Rich. Flowers, reduced.

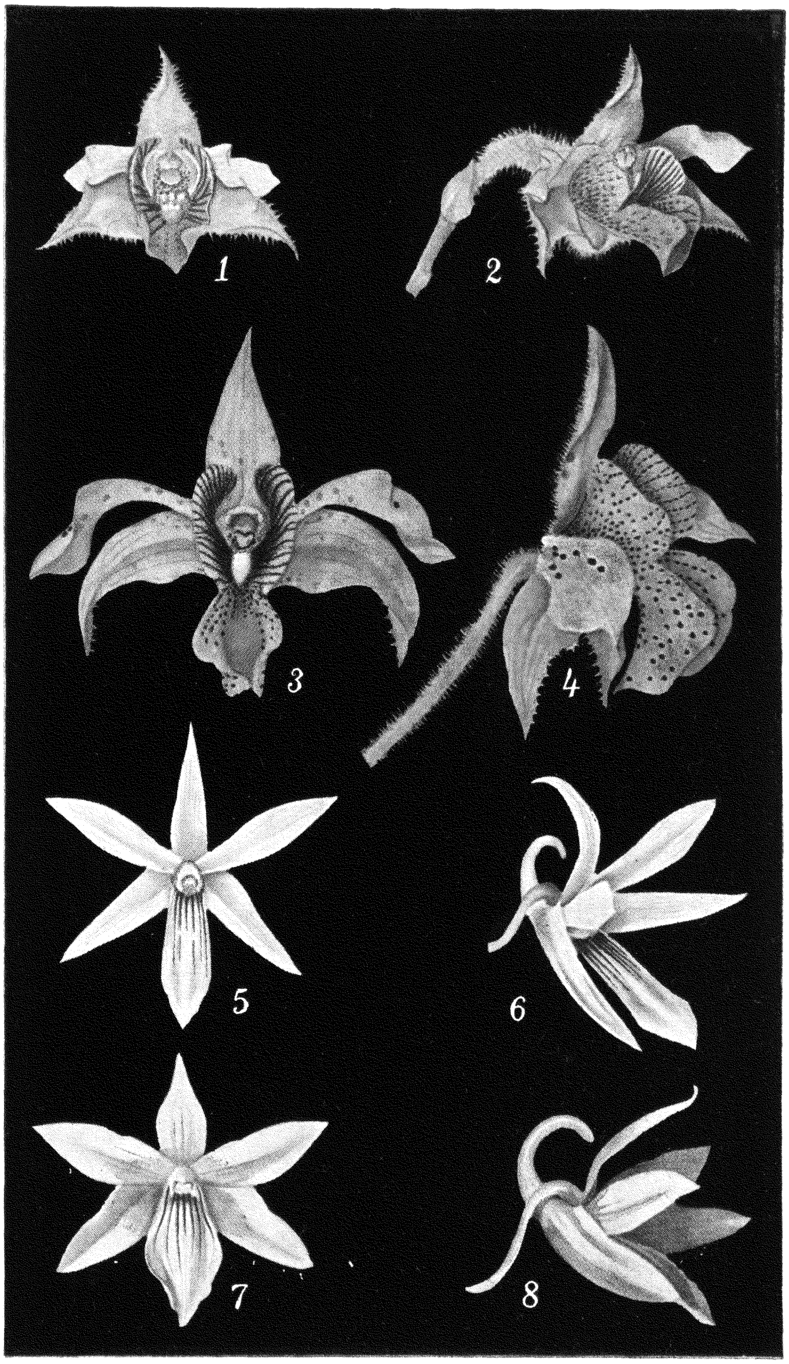

PLATE 1.

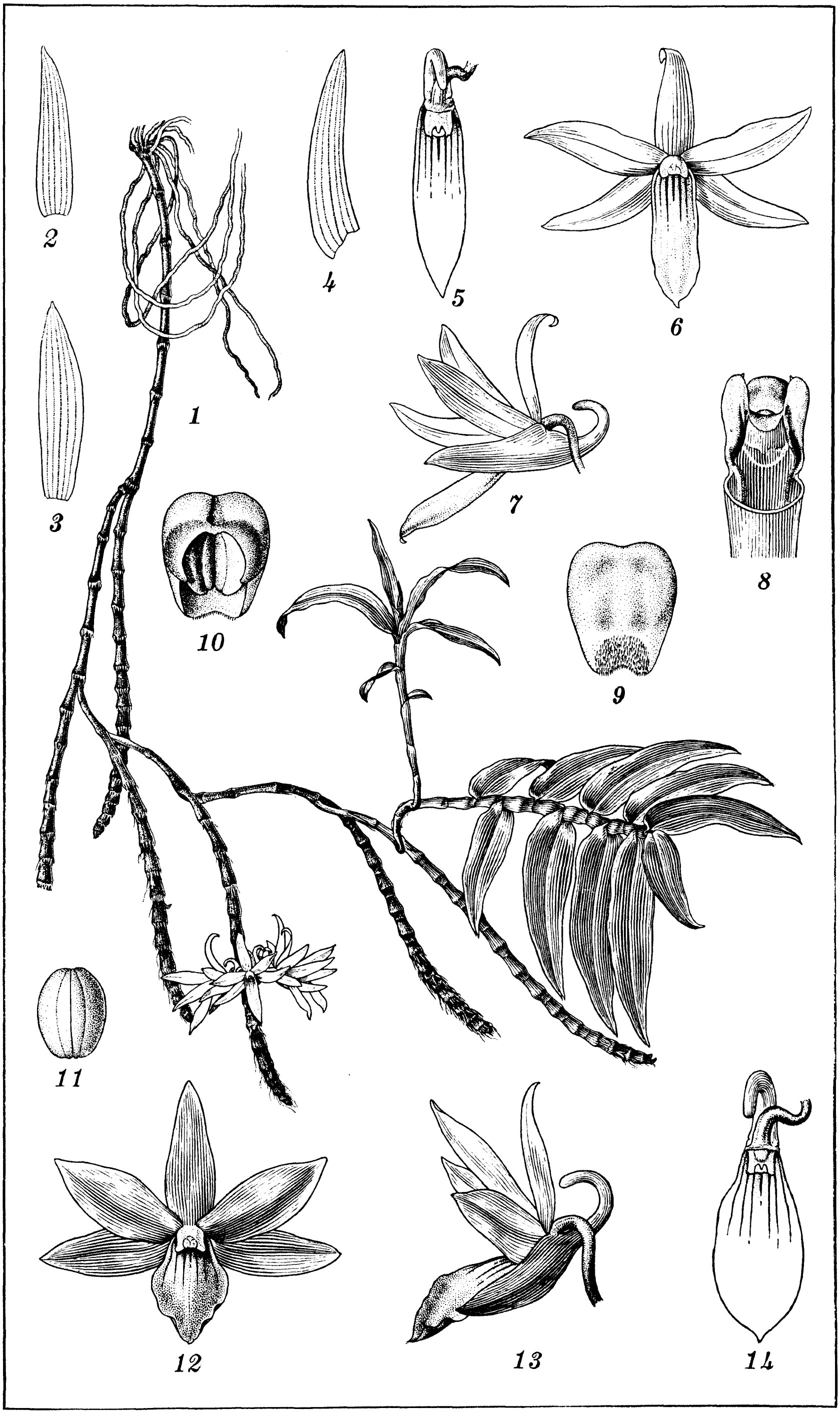

PLATE 2.

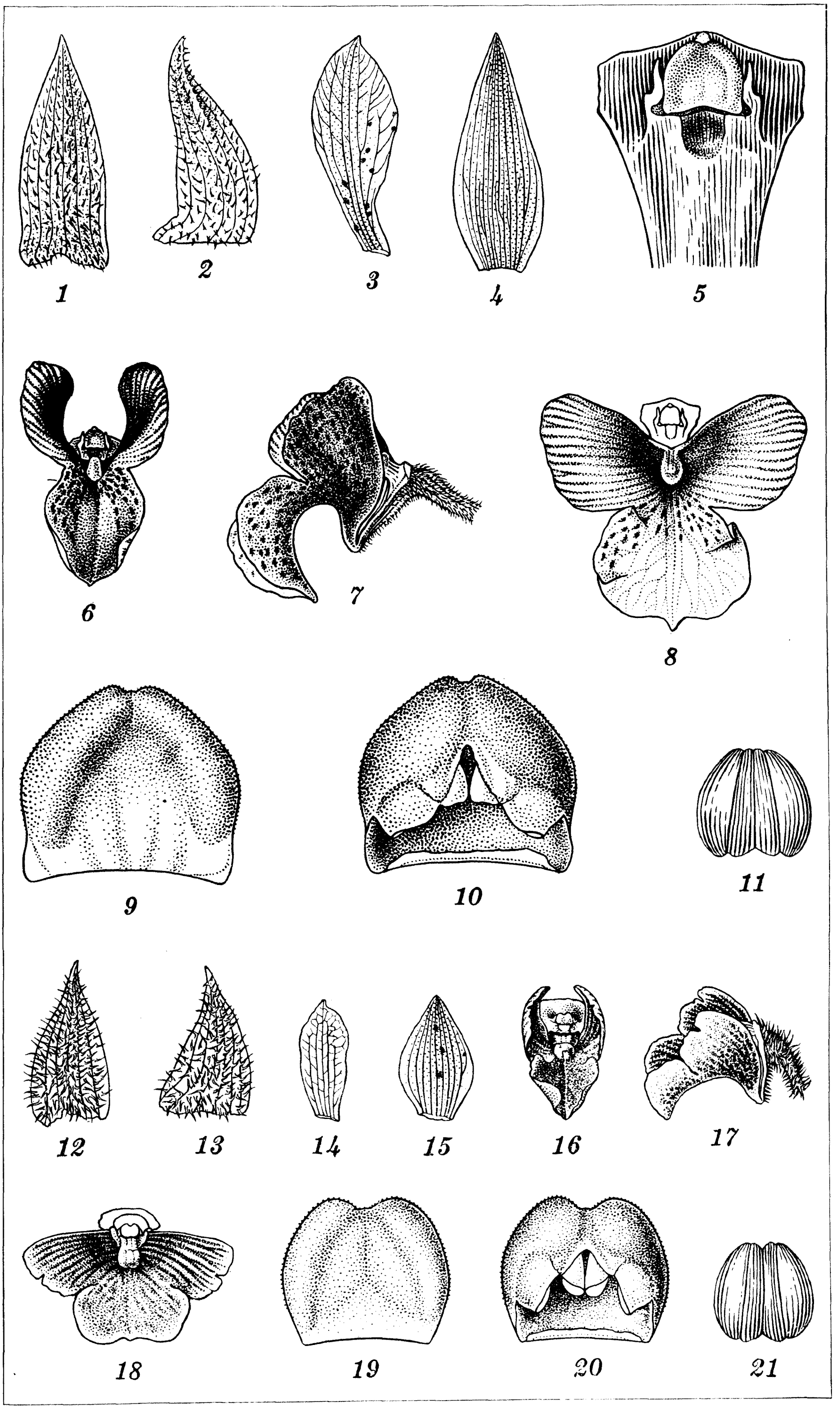

PLATE 3.

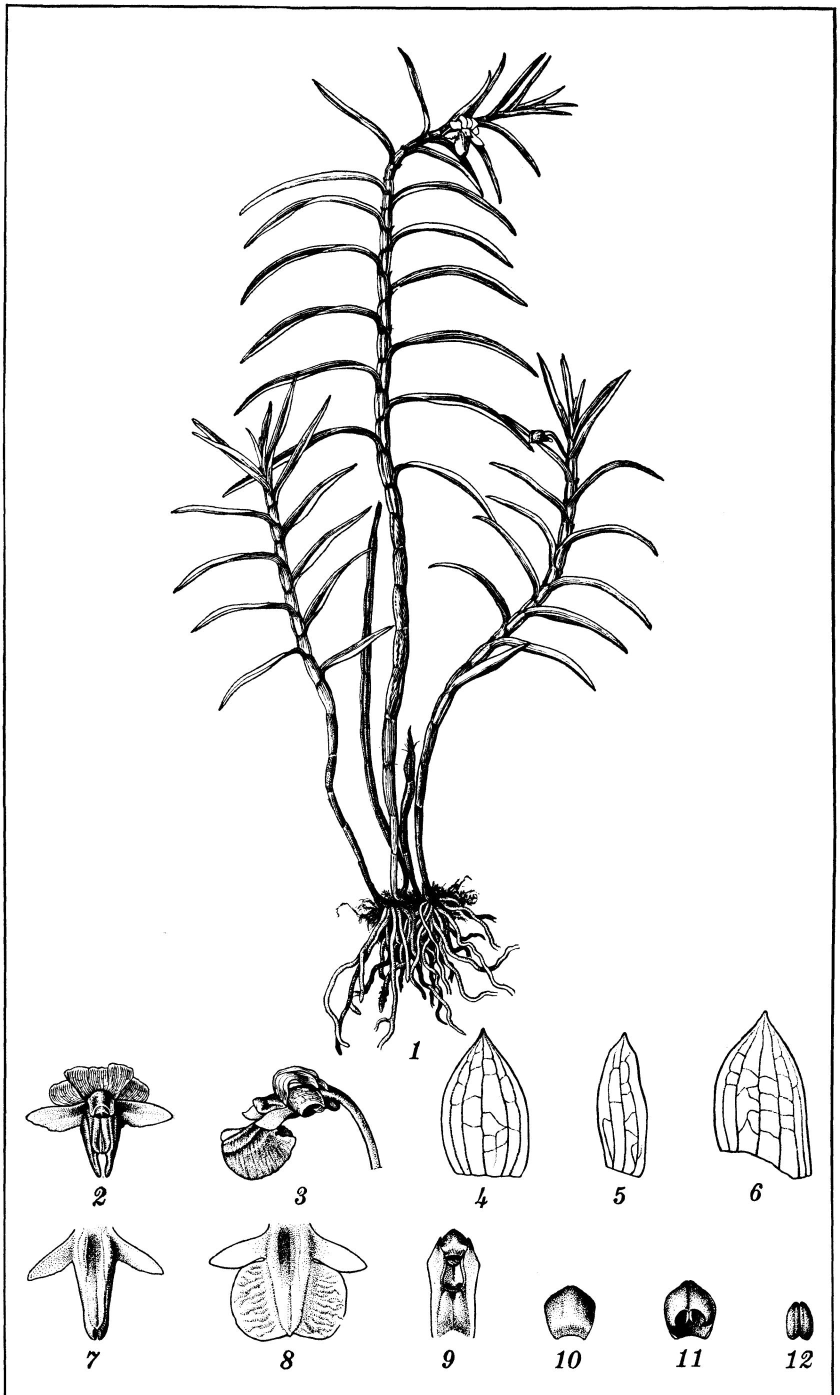

PLATE 4.

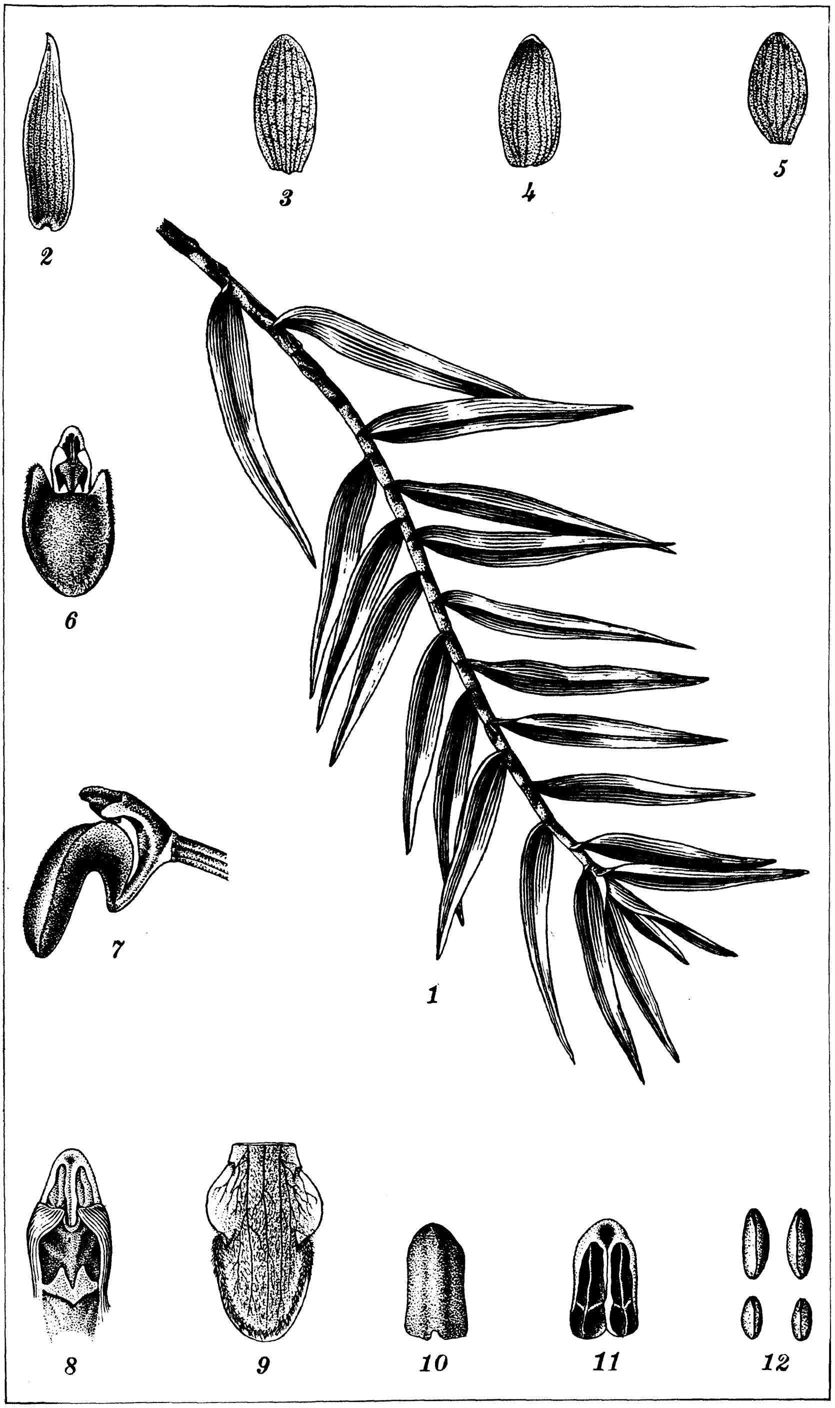

PLATE 5.

PLATE 6.

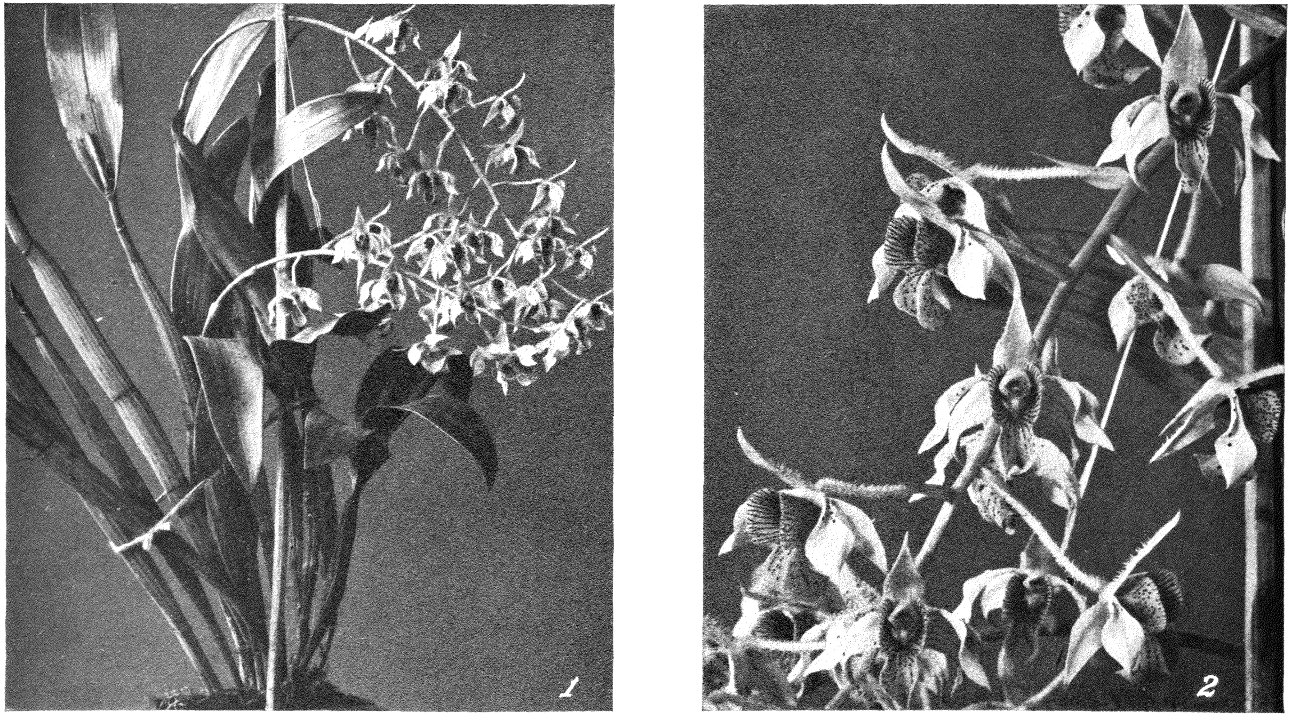

PLATE 7.

CHEMICAL FRACTIONATION OF LEPROTIC NODULES, I [1]

ISOLATION OF THE LIPID FRACTIONS

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INTRODUCTION

Undoubtedly one of the major obstacles to progress in the study of the complex problems of human leprosy is the apparent noncultivability of its causative agent. However, the skin lesion known as the leprotic nodule is fortunately of such a unique nature as to constitute an ideal source of material for biologic and chemical study. This tissue is usually heavily laden with *Mycobacterium lepræ*. The nodules can be easily removed without much discomfort to the patient, and most lepers, in this Colony at least, have no objection to and even welcome the excision of some of their larger nodules.

A saline suspension of the ground leprotic nodules has been used for studying certain biological aspects of leprosy. Teague(10) appears to be the first to employ a leprous extract for studying skin reaction in lepers, but he apparently failed to take cognizance of its significance. Mitsuda(7) appeared to be the first to call attention to the biological importance of the test. He found significantly different responses in nodular from those in maculo-anæsthetic cases of leprosy, which he interpreted as expressing the degree of the disease. This observation was extended by his pupil, Hayashi,(5) by Mariani,(6) Bargehr,(2) Chiyuto,(3) Fernandez,(4) and Schujman,(9) to mention only some of the later workers.

The biological reactions obtained from the use of this preparation have been produced not only by the presumably living but also by the dead bacilli. Also, the degree or intensity of reaction apparently depends on the quantity of bacilli in the preparation. These findings would suggest that some constituent, single or complex, derived either from the bacilli directly or from their

[1] Published with the approval of the Director of Health.

metabolites, is responsible for the reaction. In the leprolin preparations as heretofore employed by investigators, obviously a very complex mixture is involved, in which the active substance is only one of many constituents. It is evident, then, that the present leprolin test is unsatisfactory from the quantitative viewpoint. It was probably the realization of this fact that led Montanes(8) to attempt to obtain purely bacillary material from leprotic nodules. To accomplish this he digested the heavily infected leprotic tissue with strong alkali, and then centrifuged it so as to throw off the leprosy organisms. He claimed that with a suspension of the separated organisms in physiological salt solution he obtained skin reactions comparable to those from ordinary "leprolin." While this may be considered a refinement of the leprolin test and a step toward the elucidation of the phenomenon of leprolin reaction, the method still leaves something to be desired. It should be considered that the leprosy organisms may vary in age, strain(?), virulence, acid-fastness, and in other factors that may influence the reactions. Again, the leprosy bacillus is presumably of complex composition, and different constituents of a given organism have each their own specific biological properties. In view of the above considerations, a preparation containing only the active principle, free as much as possible from contaminating substances, would seem highly desirable and should be able to elicit a fairly constant skin reaction under certain conditions.

Toward this end, and with the further aim of finding materials that may apply to the study of problems related to the immunology of leprosy the present work was undertaken.

In the present work it was considered necessary to undertake first the isolation of the lipid fractions, firstly because the removal of this constituent, especially from acid-fast bacilli, has been found to facilitate the extraction of the nonlipid constituents, and secondly because of the biological importance ascribed to the lipids.

EXPERIMENTAL PROCEDURE

The nodules, which were freshly removed, were immediately transferred to a sterile container, the blood washed out with double-distilled water, and the adhering fibrous tissue trimmed off; the material thus cleaned was weighed, cut into very small pieces first with a dissecting knife then with scissors, and finally dried in a vacuum oven at a temperature of not more than 40° C.

The weight of the dissected material before drying was 105.2 grams; this was reduced to only 20.4 grams. The loss of 84.8 grams, or 80.6 per cent, represents the water content of the nodules. The dried material was then ground in a thoroughly cleaned meat grinder. The lipid fractions were isolated in the form of a phosphatide, an acetone-soluble fat, and a wax, according to the method used by Anderson in his chemical study of the tubercle bacillus.(1) The extractions were made at room temperature, so as to conserve as much as possible the constituents in the form in which they existed in the living cells.

Isolation of phosphatides.—The ground tissue was placed in a 500 cc bottle containing 200 cc of a mixture of equal volume of purified alcohol and ether. The whole mixture was allowed to stand at room temperature for four weeks, with occasional shaking of the container each day. At the end of the period the solution had changed from colorless to pale yellow. After the solvent was filtered off in a Buchner funnel, the tissue residue turned out as a pale-brown, hard mass. This residue was immediately mixed with about 100 cc of chemically pure chloroform in a 150 cc Pyrex Erlenmeyer flask and allowed to stand at room temperature, to be worked out later for the extraction of wax as described below. The alcohol-ether filtrate containing the extracted material contained an insoluble residue which settled down to the bottom of the container on standing. This residue was separated off by centrifuging and added to the residue under treatment with chloroform.

The ether in the alcohol-ether filtrate supposedly containing the phosphatides was removed by distillation under reduced pressure. The remaining undistilled portion was optically clear but of a much deeper color, nearly red. It was shaken with ether repeatedly in a separatory funnel until the lipids were extracted. The ethereal extract was then dried with anhydrous sodium sulphate overnight, filtered, and finally concentrated in the vacuum oven at a temperature not above 40° C. To the concentrate an equal volume of pure acetone was added and then left to stand for 24 hours. A light-orange precipitate of phosphatides was obtained, which darkens immediately to a deep brown when separated from its mother liquor. This precipitate was washed once with acetone, and the washings and the mother liquor, combined and treated again with acetone, allowed to stand overnight in the ice box. A further precipitate of phosphatides was obtained and the mother liquor saved for the isolation of

acetone-soluble fat. The two precipitates just described were redissolved in sufficient amounts of ether, which were combined and finally added to an equal volume of ice-cold acetone. A very pale yellow, granular precipitate of phosphatides was obtained, which on exposure to air lost its crystalline appearance, with its color deepened to reddish brown. The odor was strong and fishy, and appeared somewhat hygroscopic. The total weight of the phosphatides obtained was 650 mgs, or about 3.2 per cent of the dry weight of the ground tissue. The amount of material was too small to permit further purification for chemcial analysis.

Isolation of the acetone-soluble fat.—After the precipitation of the phosphatide just described, the acetone mother liquors containing the dissolved acetone-soluble fats were united, and the solvent was distilled off with the aid of a vacuum pump at a temperature not above 40° C. The residue was then completely dried in a current of air from an electric fan and finally in a vacuum desiccator over sulphuric acid. The product obtained weighed 1.3 grams, or about 6.4 per cent of the dry weight of the original material. It was of oily consistency and of deep wine color. After a few days standing at room temperature the mass separated into an oily and a solid portion, a small oily red portion being in the upper layer and a larger yellow solid substance occupying mainly the lower portions. The odor was characteristic but not as offensive as that of the phosphatides.

Extraction of wax with chloroform.—The tissue, which was macerated with chloroform after having been treated with the alcohol-ether mixture, was separated from its chloroform solvent by filtration in a Buchner funnel. The remaining unextracted tissue residue was immediately mixed with about 200 cc of distilled water containing 0.5 per cent phenol, and allowed to stand at room temperature to be worked out later for the isolation of proteins.[2] The filtrate comprising the chloroform extract was subjected to vacuum distillation at a temperature not above 40° C. until all the chloroform had been removed. The undistilled portion, consisting of the extracted wax, had the consistency of a syrupy mass, homogeneous in appearance, deep red, and weighing 0.3 grams, or about 1.5 per cent of the dry weight of the original material. The odor was characteristic.

[2] The work on the isolation of proteins will form the second part of this paper which will appear at a later date.

Solubility.—The solubility of each of the fractions isolated was tried on vehicles which are commonly employed for parenteral injections. The phosphatide fraction was found to be insoluble both in water and in physiological salt solution, but it gave a fine suspension with these vehicles. The acetone-soluble fat and the wax were both very immiscible with water and with physiological salt solution, but both were quite soluble in an oily solvent, like olive oil.

Skin test.—The isolated lipid fractions described in this paper were subjected to a preliminary skin test [3] on a few leprosy cases, and according to the results so far obtained the wax was found to possess the property of eliciting a definite skin reaction simulating, but not as intense or as distinctive as, that from an ordinary leprolin preparation, with respect to the neural and the cutaneous types of leprosy. The acetone-soluble fat and the phosphatide, at the concentration employed, gave practically negative results.

SUMMARY

Leprotic nodules removed from living cases were subjected to a systematic fractionation into the major lipid components, such as phosphatide, acetone-soluble fat, and wax, as part of the work being undertaken on nodular tissue with a view (*a*) to isolate the principal constituent of leprotic tissue that is responsible for the leprolin reaction, and (*b*) to search for materials that may find application in the study of problems related to the immunochemistry of leprosy.

Preliminary skin tests on a few cases of leprosy showed that of the lipid fractions isolated, only the wax appears to possess a significant biological property.

ACKNOWLEDGMENT

The author desires to express his thanks to Dr. C. B. Lara, chief physician of the medical section of the Culion Leper Colony, for his suggestions in connection with the preparation of this paper.

[3] The test was performed by Dr. M. Lagrosa, of the medical section of the Culion Leper Colony, to whom the author expresses his thanks. The method consisted in injecting intradermally in the forearm 0.1 cc of a solution or suspension in physiological salt solution or purified olive oil containing 1 mg of the substance isolated, using as controls the solvents used and a leprolin preparation. The reactions were observed after 48 hours and weekly thereafter for one month. The tests will be continued on a larger number of cases and the results reported in a separate paper.

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DIATOMS FROM A PEATY BOG IN LIANCHIHO RIVER VALLEY, EASTERN SIBERIA

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Of Harbin, Manchoukuo

THREE PLATES

Several years ago I received through Mr. I. P. Popov, of the Botanical Laboratory of Far Eastern University, Vladivostok, a sample of diatoms collected by him during a botanical survey of Primorsk Province in a *Carex-Sphagnum* peaty bog in Lianchiho River valley, about 40 kilometers west of Vladivostok, not far from the seashore.

The diatoms collected were essentially northern in character, and presented great similarity to those of northern Manchoukuo, Nippon, and Korea. The presence in Lianchiho valley of *Eunotia monodon* var. *koreana* and *Pinnularia nobilis* var. *parallela* recently reported as fossils from Korea is interesting. Some of the new species, as *Achnanthes fragilis* and *Caloneis sphagnicola*, found in mountain bogs of northern Manchuria, were recognized in the present collection. *Pinnularia gentilis* var. *sibirica*, reported from Lake Kenon of Transbaikalia, was also found in Lianchiho valley. Several Manchurian diatoms, as *Pinnularia streptoraphe* var. *interrupta*, *Pinnularia distinguenda* var. *asiatica*, *Cymbella turgida* var. *muscosa*, and *Nitzschia capitellata* var. *montana*, were also represented in the sample. Among 94 different forms of diatoms listed in the present paper, 20 are proposed as new to science. They are as follows:

Eunotia asiatica sp. nov.
Eunotia asiatica var. *interrupta* var. nov.
Eunotia monodon Ehr. var. *koreana* Skv. fo. *bidens* fo. nov.
Navicula muscosa sp. nov.
Navicula sohrensis var. *parallela* var. nov.
Navicula cincta fo. *sphagnicola* fo. nov.
Pinnularia subcapitata fo. *tenua* fo. nov.
Pinnularia divergentissima var. *lata* var. nov.
Pinnularia karelica var. *subcapitata* var. nov.
Pinnularia subsolaris var. *asiatica* var. nov.
Pinnularia gibba fo. *polymorpha* fo. nov.
Pinnularia viridis var. *orientalis* var. nov.
Pinnularia nobilis var. *distincta* var. nov.

Pinnularia distinguenda var. *sphagnicola* var. nov.
Pinnularia isostauron var. *orientalis* var. nov.
Pinnularia sphagnicola sp. nov.
Cymbella amphioxys var. *asiatica* var. nov.
Cymbella perpusilla fo. *elongata* fo. nov.
Cymbella gracilis fo. *sphagnicola* fo. nov.
Gomphonema longiceps var. *montana* fo. *minuta* fo. nov.

Both Latin and English diagnoses are given for new forms. The drawings were made by the author with E. Leitz Apochromat 2 mm and Compens Okular No. 4.

TABELLARIA FENESTRATA (Lynb.) Kützing.

Tabellaria fenestrata (Lynb.) Kützing, FR. HUSTEDT, Bacillar. (1930) 122, 123, fig. 99.

Infrequent. Reported from bogs and peaty moors.

EUNOTIA PAPILIO Ehr. Plate 3, fig. 5.

Eunotia papilio Ehr., A. SCHMIDT, Atlas Diatom. (1911) pl. 273, fig. 34.

Valve arcuate, with slightly concave ventral and broad arcuate dorsal margin. Ends rostrate-capitate, obtuse. End nodules distinct, curved. Striæ radiate, 9 in 0.01 mm. Between striæ on the dorsal margin shorter marginal striæ. Length, 0.06 mm; breadth 0.02. Infrequent.

EUNOTIA PRAERUPTA Ehr. Plate 3, figs. 3, 4, 10, and 18.

Eunotia praerupta Ehr., A. SCHMIDT, Atlas Diatom. (1911) pl. 273, figs. 12–14, 25.

Valve arcuate, with slightly concave ventral margin and broad subcapitate ends. Two distinct forms have been observed. (1) Valve with robust striæ. Length, 0.045 to 0.074 mm; breadth, 0.0135 to 0.017. Striæ 4 to 7 in 0.01 mm (Plate 3, figs. 3 and 4). (2) Valve with coarser striæ, about 12 in 0.01 mm. Length, 0.054 to 0.093 mm; breadth, 0.015 to 0.017 (Plate 3, figs. 10 and 18). Very common.

EUNOTIA PRAERUPTA Ehr. fo. CURTA Grunow. Plate 1, fig. 29.

Eunotia praerupta Ehr. fo. *curta* Grunow, A. SCHMIDT, Atlas Diatom. (1911) pl. 273, figs. 10, 11.

Smaller than the type. Length, 0.025 mm; breadth, 0.0085. Striæ 12 in 0.01 mm. Not common.

EUNOTIA PRAERUPTA Ehr. var. BIDENS Grunow. Plate 3, figs. 6 and 21.

Eunotia praerupta Ehr. var. *bidens* Grunow, A. SCHMIDT, Atlas Diatom. (1911) pl. 273, figs. 26–28, 32, 33.

Differs from the type in its biarcuate dorsal margin. Length, 0.032 to 0.068; breadth, 0.0051 to 0.0136. Striæ 7 to 15 in 0.01 mm. Very common.

EUNOTIA PRAERUPTA Ehr. var. INFLATA Grunow. Plate 3, fig. 15.

Eunotia praerupta Ehr. var. *inflata* Grun., A. SCHMIDT, Atlas Diatom. (1911) pl. 273, figs. 12, 23.

Valve arcuate, with almost straight ventral and moderately arcuate dorsal margin. Length, 0.045 to 0.051 mm; breadth, 0.0157 to 0.017. Striæ 7 to 10 in 0.01 mm. Very common.

EUNOTIA PRAERUPTA Ehr. var. INFLATA Grun. fo. CURTA Grunow. Plate 3, fig. 11.

Eunotia praerupta Ehr. var. *inflata* Grun. fo. *curta* Grunow, A. SCHMIDT, Atlas Diatom. (1911) pl. 273, fig. 18.

Valve length, 0.04 mm; breadth, 0.017. Striæ 7 to 8 in 0.01 mm. Common.

EUNOTIA PRAERUPTA Ehr. var. LATICEPS Grunow. Plate 2, fig. 13.

Eunotia praerupta Ehr. var. *laticeps* Grunow, A. SCHMIDT, Atlas Diatom. (1911) pl. 273, figs. 15–17.

Valve length, 0.0238 mm; breadth, 0.006. Striæ 12 in 0.01 mm. Infrequent.

EUNOTIA BIGIBBA Kütz. var. PUMILA Grunow. Plate 1, fig. 15; Plate 3, figs. 14, 19, and 22.

Eunotia bigibba Kütz. var. *pumila* Grunow, A. SCHMIDT, Atlas Diatom. (1911) pl. 274, figs. 58–64.

Valve small, robust, arcuate, ventral margin concave only in the middle part, dorsal biarcuate with produced broad-obtuse ends. Striæ slightly radiate, 12 to 15 in 0.01 mm. Length, 0.012 to 0.02 mm; breadth, 0.005. Common.

EUNOTIA ARCUS Ehr. Plate 2, figs. 18? and 20.

Eunotia arcus Ehr., A. SCHMIDT, Atlas Diatom. (1911) pl. 274, figs. 33–43, 55.

Valve arcuate, with concave ventral and arcuate dorsal margin. Length, 0.025 to 0.027 mm; breadth, 0.0034 to 0.0042. Striæ 15 in 0.01 mm. Infrequent.

EUNOTIA ARCUS Ehr. var. BIDENS Grunow. Plate 1, fig. 14; Plate 2, figs. 16 and 17.

Eunotia arcus Ehr. var. *bidens* Grunow, A. SCHMIDT, Atlas Diatom. (1911) pl. 274, fig. 46.

Valve arcuate, biundulate, with capitate, abrupt, ends. Length, 0.0187 mm; breadth, 0.0034. Striæ 15 in 0.01 mm. Common.

EUNOTIA TENELLA (Grun.) Hustedt. Plate 2, figs. 10 and 14.

Eunotia tenella (Grun.), FR. HUSTEDT, Bacillar. (1930) 175, fig. 220.

Valve moderately arcuate, with slightly concave ventral and arcuate dorsal sides. Ends subcapitate. Length, 0.015 to 0.02

mm; breadth, 0.0025. Striæ 15 in 0.01 mm. Somewhat narrower than the type. Common. Reported from moss bogs.

EUNOTIA TRIDENTULA Ehr. var. PERMINUTA Grunow. Plate 2, fig. 11.

Eunotia tridentula Ehr. var. *perminuta* Grunow, FR. HUSTEDT, Bacillar. (1930) 180, fig. 233.

Valve minute, with ventral margin biundulate, dorsal triundulate. Ends obtuse and abrupt. Length, 0.012 mm; breadth, 0.0034. Striæ 15 in 0.01 mm. Infrequent. Reported from moss bog of Gaolinitze, northern Manchuria.

EUNOTIA PECTINALIS (Kütz.) Rabh.

Eunotia pectinalis (Kütz.) Rabh., FR. HUSTEDT, Bacillar. (1930) 180, 181, fig. 237.

Valve almost straight, with arcuate dorsal margin and subrostrate ends. Length, 0.068 mm; breadth, 0.006. Striæ 11 to 12 in 0.01 mm. Rare.

EUNOTIA PECTINALIS (Kütz.) Rabh. var. MINOR (Kütz.) Rabh. fo. IMPRESSA (Ehr.). Plate 2, fig. 19.

Eunotia pectinalis (Kütz.) Rabh. var. *minor* (Kütz.) Rabh. fo. *impressa* (Ehr.), FR. HUSTEDT, Bacillar. (1930) 182, fig. 239.

Valve with almost straight ventral and biarcuate dorsal margin. Length, 0.019 mm; breadth, 0.0034. Striæ 15 to 18 in 0.01 mm. Rare.

EUNOTIA KOCHELIENSIS O. Müll. Plate 3, figs. 9 and 12.

Eunotia kocheliensis O. Müll., FR. HUSTEDT, Bacillar. (1930) 182, fig. 244.

Valve semielliptic, short, with broad-rounded ends. Length, 0.0076 to 0.01 mm; breadth, 0.0045 to 0.0051. Striæ 11 to 12 in 0.01 mm. Somewhat narrower than the type. Infrequent. Reported from Europe.

EUNOTIA VENERIS (Kütz.) O. Müll. Plate 1, fig. 31.

Eunotia veneris (Kütz.) O. Müll., A. SCHMIDT, Atlas Diatom. (1913) pl. 294, figs. 13–15.

Valve semielliptic, with straight ventral and arcuate dorsal margins, produced to the rounded ends. Length, 0.014 to 0.032 mm; breadth, 0.0034 to 0.004. Striæ 12 in 0.01 mm. Common.

EUNOTIA ASIATICA sp. nov. Plate 1, figs. 17, 18, and 33.

Valvis modice inflexis, ventre constrictis, dorso concavis cum polis obtusis rotundatis, nodulis terminalis distinctis. Striis transversis, 15 in 0.01 mm. Longis valvis 0.0085 ad 0.017 mm; latis valvis 0.002 ad 0.0029. Habit. in aquis stagnalis prope

Lianchiho rivum. Primorsk Prov., Siberia orientalis. Legit I. P. Popov.

Valve lunate, ventral margin concave, dorsal arcuate, with broad-rounded ends. End nodules small. Striæ fine, about 15 in 0.01 mm. Length, 0.0085 to 0.017 mm; breadth, 0.002 to 0.0029. Common. A species akin to *Eunotia lunaris* (Ehr.) Grun.

EUNOTIA ASIATICA sp. nov. var. INTERRUPTA var. nov. Plate 1, fig. 35.

Differt a typo medium valvis interruptis et parallelis. Longis valvis 0.0155 mm; latis valvis 0.0021. Striis 15 in 0.01 mm. Cum forae typicum.

Differs from the type in the straight middle part with parallel margins. Infrequent.

EUNOTIA ELEGANS Oestrup. Plate 2, fig. 27.

Eunotia elegans Oestrup, FR. HUSTEDT, Bacillar. (1930) 183, fig. 248.

Valve distinctly lunate, with capitate ends. Length, 0.039 mm; breadth, 0.0025. Striæ 20 in 0.01 mm. Infrequent. Reported from northern Europe.

EUNOTIA ALPINA (Naeg.) Hust.

Eunotia alpina (Naeg.) FR. HUSTEDT, Bacillar. (1930) 185, fig. 252.

Valve slightly curved, with moderately reflexed ends. Length, 0.051 mm; breadth, 0.028. Striæ 15 in 0.01 mm. Common.

EUNOTIA GRACILIS (Ehr.) Rabh. Plate 1, fig. 8.

Eunotia gracilis (Ehr.) Rabh., FR. HUSTEDT, Bacillar. (1930) 185, fig. 253.

Valve lunate, very narrow, with slightly capitate ends. Length, 0.093 to 0.102 mm; breadth, 0.005 to 0.0055. Striæ 10 to 12 in 0.01 mm. Common.

EUNOTIA MONODON Ehr. var. KOREANA Skvortzow. Plate 3, fig. 2.

Eunotia monodon Ehr. var. *koreana* SKVORTZOW, Neogene diatoms from environs of Gensan, Korea (1936) pl. 1, figs. 13, 14, 19?, 20, 30, 33.

Valve slightly curvate, moderately arcuate at the dorsal margin. Ends recurved, broad-rounded. Length, 0.054 mm; breadth, 0.0068. Striæ 11 to 12 in 0.01 mm. Common. Reported as a fossil from Korea.

EUNOTIA MONODON Ehr. var. KOREANA Skvortzow fo. BIDENS fo. nov. Plate 1, fig. 30; Plate 2, fig. 23; Plate 3, fig. 13.

Differt a var. koreana marginem dorsali biarcuatis. Longis valvis 0.034 ad 0.051 mm; latis valvis 0.0068 ad 0.0085. Striis

9 ad 12 in 0.01 mm. Habit. in aquis stagnalis prope Lianchiho rivulum, Primorsk Prov., Siberia Orientalis. Legit I. P. Popov.

Differs from var. *koreana* in biundulate dorsal margin. Infrequent.

ACHNANTHES MINUTISSIMA Kützing.

Achnanthes minutissima Kützing, FR. HUSTEDT, Bacillar. (1930) 198, fig. 274.

Valve narrow lanceolate with obtuse ends. Length, 0.012 mm; breadth, 0.0025. Infrequent.

ACHNANTHES LINEARIS W. Smith. Plate 1, fig. 36.

Achnanthes linearis W. Smith, FR. HUSTEDT, Bacillar. (1930) 198, fig. 276.

Valve elliptic-lanceolate with broad ends. Length, 0.01 mm; breadth, 0.0028. Striæ indistinct. Not common.

ACHNANTHES LINEARIS W. Smith var. **PUSILLA** Grun. Plate 1, fig. 11.

Achnanthes linearis W. Smith var. *pusilla* Grun., FR. HUSTEDT, Bacillar. (1930) 198, fig. 277.

Valve linear with broad ends. Length, 0.0136 mm; breadth, 0.0028. Striæ 18 in 0.01 mm. Infrequent.

ACHNANTHES FRAGILIS Skvortzow. Plate 1, figs. 32 and 34.

Achnanthes fragilis SKVORTZOW, Diatoms flora of a mountain bog, Kaolingtze, Pin-Chiang-Sheng Province, Manchoukuo (1938) pl. 1, fig. 26.

Valve elliptic, with obtuse ends. Length, 0.005 to 0.0068 mm; breadth, 0.0017 to 0.0025. Striæ indistinct. Common. Reported from Kaolingtze, northern Manchuria.

FRUSTULIA RHOMBOIDES (Ehr.) de Toni.

Frustulia rhomboides (Ehr.) de Toni, FR. HUSTEDT, Bacillar. (1930) 220, fig. 324.

Valve rhombic-lanceolate, tapering from the middle to subacute ends. Length, 0.093 mm; breadth, 0.018. Infrequent. Common in mountain bogs.

FRUSTULIA RHOMBOIDES (Ehr.) de Toni var. **SAXONICA** (Rabh.) de Toni.

Frustulia rhomboides (Ehr.) de Toni var. *saxonica* (Rabh.) de Toni, FR. HUSTEDT, Bacillar. (1930) 221, fig. 325.

Smaller than the type. Valve elliptic-lanceolate. Length, 0.049 to 0.068 mm; breadth, 0.0085 to 0.015. Very common.

FRUSTULIA RHOMBOIDES Ehr. var. **LINEOLATA** Ehr. Plate 2, fig. 22.

Frustulia rhomboides Ehr. var. *lineolata* EHRENBERG, Microgeologie (1856) 16; pl. 1, fig. 3.

Valve lanceolate, with five coarse longitudinal furrows on each side. Length, 0.054 mm; breadth, 0.012. Infrequent.

CALONEIS SILICULA (Ehr.) Cleve var. ALPINA Cleve. Plate 3, fig. 20.

Caloneis silicula (Ehr.) Cleve var. *alpina* Cleve, FR. HUSTEDT, Bacillar. (1930) 238, fig. 366.

Valve linear, triundulate, with obtuse-rounded ends. Length, 0.022 mm; breadth, 0.0056. Very rare. Reported from mountain districts.

CALONEIS SPHAGNICOLA Skvortzow. Plate 3, fig. 24.

Caloneis sphagnicola SKVORTZOW, Diatoms flora of a mountain bog, Kaolingtze, Pin-Chiang-Sheng Province, Manchoukuo (1938) pl. 1, fig. 27.

Valve linear-lanceolate, with slightly gibbous middle part and protracted ends. Length, 0.035 mm; breadth, 0.005. Striæ 22 in 0.01 mm. Rare. Reported from Kaolingtze, northern Manchuria.

NEIDIUM BISULCATUM (Lagerst.) Cleve.

Neidium bisulcatum (Lagerst.) Cleve, FR. HUSTEDT, Bacillar. (1930) 242, fig. 374.

Infrequent. Length, 0.04 mm; breadth, 0.0068. Striæ 30 in 0.01 mm. Not common.

NEIDIUM BISULCATUM (Lagerst.) Cleve fo. UNDULATA O. Müll. Plate 1, fig. 1.

Neidium bisulcatum (Lagerst.) Cleve fo. *undulata* O. Müll., FR. HUSTEDT, Bacillar. (1930) 242, fig. 375.

Valve slightly gibbous in the middle part. Length, 0.085 mm; breadth, 0.01. Striæ 21 to 25 in 0.01 mm. Larger than the type. Common.

NEIDIUM IRIDIS (Ehr.) Cleve var. AMPLIATA (Ehr.) Cleve.

Neidium iridis (Ehr.) Cleve var. *ampliata* (Ehr.) Cleve, FR. HUSTEDT, Bacillar. (1930) 245, fig. 381.

Valve elliptic-lanceolate, with obtuse ends. Length, 0.093 to 0.098 mm; breadth, 0.03 to 0.032. Striæ 20 in 0.01 mm. Infrequent.

DIPLONEIS OVALIS (Hilse) Cleve.

Diploneis ovalis (Hilse) Cleve, FR. HUSTEDT, Bacillar. (1930) 249, fig. 390.

Valve elliptic, with broad ends. Length, 0.03 mm; breadth, 0.013. Striæ 14 in 0.01 mm. Rare.

DIPLONEIS PUELLA (Schum.) Cleve.

Diploneis puella (Schum.) Cleve, FR. HUSTEDT, Bacillar. (1930) 250, fig. 394.

Valve elliptic. Striæ indistinctly punctate. Length, 0.027 to 0.028 mm; breadth, 0.0135 to 0.014. Striæ 12 to 14 in 0.01 mm. Rare.

STAURONEIS ANCEPS Ehr.

Stauroneis anceps Ehr., FR. HUSTEDT, Bacillar. (1930) 256, fig. 405.

Infrequent. Length, 0.074 mm; breadth, 0.0136. Striæ 18 in 0.01 mm.

STAURONEIS ANCEPS Ehr. fo. **LINEARIS** (Ehr.) Cleve.

Stauroneis anceps Ehr. fo. *linearis* (Ehr.) Cleve, FR. HUSTEDT, Bacillar. (1930) 256, fig. 407.

Valve linear-elliptic, with parallel margins and attenuate capitate ends. Length, 0.051 mm; breadth, 0.09. Infrequent.

STAURONEIS PHOENICENTERON Ehr.

Stauroneis phoenicenteron Ehr., FR. HUSTEDT, Bacillar. (1930) 255, fig. 404.

Valve lanceolate, tapering from the middle to the subacute ends. Length, 0.17 mm; breadth 0.035. Infrequent.

NAVICULA PLACENTA Ehr.

Navicula placenta Ehr., FR. HUSTEDT, Bacillar. (1930) 290, fig. 492.

Valve elliptic, with small rostrate ends. Length, 0.039 mm; breadth, 0.015. Striæ 25 in 0.01 mm. Infrequent. Reported from Kaolingtze, northern Manchuria. Common in alpine districts.

NAVICULA MUSCOSA sp. nov. Plate 1, fig. 20.

Valvis lineari-lanceolatis marginem parallelis attenuatis cum polis rostratis obtusis. Area axillaris et centralis anguste linearis. Striis delicatissimis longitudinalis indistinctis. Longis valvis 0.018 mm; latis valvis 0.005. Habit. in aquis stagnalis prope Lianchiho rivulis, Primorsk Prov., Siberia Orientalis. Legit I. P. Popov.

Valve linear-lanceolate, with rostrate ends. Median line filiform. Axial and central area very narrow linear. Striæ forming indistinct longitudinal lines. Length, 0.018 mm; breadth, 0.005. Rare. Belongs to Sect. Naviculæ minusculæ Cleve.

NAVICULA SOHRENSIS Krasske var. **PARALLELA** var. nov. Plate 3, fig. 16.

Differt a typo valvis linearis, area axillaris lanceolata, ad porum centralem transverse dilatata. Longis valvis 0.017 mm; latis valvis 0.0027. Striis 15 in 0.01 mm. Habit. in aquis stagnalis prope Lianchiho rivulis, Primorsk Prov., Siberia Orientalis. Legit I. P. Popov.

Valve linear-lanceolate, with slightly attenuate ends. Axial area very narrow, central area a broad rectangular fascia. Length, 0.017 mm; breadth, 0.0027. Striæ 15 in 0.01 mm. Differs from the type in its linear valves with interrupted striæ in the middle part. Rare.

NAVICULA CINCTA (Ehr.) Kütz. fo. SPHAGNICOLA fo. nov. Plate 2, fig. 29.

Valvis formae typicae consimilis, minute autem striis robustris. Longis valvis 0.042 mm; latis valvis 0.0065. Striis 10 in 0.01 mm. Habit. in aquis stagnalis prope Lianchiho rivulis, Primorsk Prov., Siberia Orientalis. Legit I. P. Popov.

Valve narrow linear-lanceolate, with attenuate-rounded ends. Length, 0.042 mm; breadth, 0.0065. Striæ 10 in 0.01 mm. More robust than the type and not longer and shorter in the middle. Infrequent.

NAVICULA IGNOTA Krasske. Plate 2, fig. 25.

Navicula ignota KRASSKE, Beiträge zur Kenntniss der Diatomeenflora der Alpen (1932) 111, fig. 19.

Valve linear-lanceolate, triundulate. Length, 0.019 mm; breadth, 0.005. Striæ 15 in 0.01 mm. Smaller than the type. Rare. Reported from northern Manchuria, and from Shanghai and Hangchow, China.

Genus PINNULARIA Ehrenberg

PINNULARIÆ CAPITATÆ

PINNULARIA APPENDICULATA (Agardh) Cleve. Plate 2, fig. 8.

Pinnularia appendiculata (Agardh) Cleve, FR. HUSTEDT, Bacillar. (1930) 317, fig. 570*a*.

Valve linear-lanceolate, with slightly attenuate and subcapitate ends. Length, 0.035 mm; breadth, 0.005. Costæ 12 to 13 in 0.01 mm. Common. Differs from the type in its more robust striæ.

PINNULARIA SUBCAPITATA Greg. fo. TENUA fo. nov. Plate 1, fig. 26.

Differt a typo valvis angustior. Longis valvis 0.024 mm; latis valvis 0.0034. Costis 12 in 0.01 mm. Habit. in aquis stagnalis prope Lianchiho rivulis, Primorsk Prov., Siberia Orientalis. Legit I. P. Popov.

Differs from the type in its narrower valves. Infrequent.

PINNULARIA MESOLEPTA (Ehr.) Smith fo. ANGUSTA Cleve. Plate 1, fig. 27.

Pinnularia mesolepta (Ehr.) W. Smith fo. *angusta* Cleve, FR. HUSTEDT, Bacillar. (1930).

Length, 0.04 to 0.047 mm; breadth, 0.005 to 0.0068. Costæ 10 to 14 in 0.01 mm. Common.

PINNULARIA BRAUNII (Grun.) Cleve.

Pinnularia Braunii (Grun.) Cleve, FR. HUSTEDT, Bacillar. (1930) 319, fig. 517.

Narrower than the type. Length, 0.042 mm; breadth, 0.0068. Costæ 12 in 0.01 mm. Rare.

PINNULARIÆ DIVERGENTES

PINNULARIA DIVERGENTISSIMA (Grun.) Cleve var. LATA var. nov. Plate 2, fig. 24.

Differt a typo valvis latio, polis obtusis. Longis valvis 0.0306 mm; latis valvis 0.0068. Costis 12 in 0.01 mm. Habit. in aquis stagnalis prope Lianchiho rivulis, Primorsk Prov., Siberia Orientalis. Legit I. P. Popov.

Valve linear-lanceolate, attenuate towards obtuse ends. Median line filiform with comma-shaped terminal fissures. Axial area narrow, widened to the middle. Central area a transverse fascia widened outwards. Costæ strong, divergent in the middle and convergent at the ends. Length, 0.0306 mm; breadth, 0.0068. Costæ 12 in 0.01 mm. Differs from the type in it broad valves with obtuse ends. Rare.

PINNULARIA KARELICA Cleve var. SUBCAPITATA var. nov. Plate 3, fig. 7.

Differt a var. japonica Hust. valvis marginem parallelis polis subrostratis. Longis valvis 0.054 mm; latis valvis 0.01. Costis 9 in 0.01 mm. Habit. in aquis stagnalis prope Lianchiho rivulis, Primorsk Prov., Siberia Orientalis. Legit I. P. Popov.

Valve linear, with parallel margins and broad-rostrate ends. Median line filiform, with comma-shaped terminal fissures. Axial area very narrow, central area a rectangular broad fascia. Costæ almost parallel or slightly radiate, moderately convergent at the ends. No longitudinal bands. Length, 0.054 mm; breadth, 0.01. Costæ 9 in 0.01 mm. Differs from var. *japonica* Hust. in its parallel margin and subrostrate ends, and by the absence of longitudinal bands.

PINNULARIA LEGUMEN Ehr. Plate 3, fig. 23.

Pinnularia legumen Ehr., FR. HUSTEDT, Bacillar. (1930) 322, fig. 587.

Valve linear, lanceolate, slightly triundulate with produced subcapitate ends. Median line filiform, with large comma-shaped terminal fissures. Axial area widened to the orbicular central area. Costæ strong, divergent in the middle and convergent at the ends, 9 in 0.01 mm. Length, 0.085 mm; breadth, 0.012. Somewhat narrower than the type. Rare.

PINNULARIA SUBSOLARIS (Grun.) Cleve var. **ASIATICA** var. nov. Plate 1, fig. 2.

Differt a typo marginem parallelis. Longis valvis 0.059 mm; latis valvis 0.01. Costis 9 in 0.01 mm. Habit. in aquis stagnalis prope Lianchiho rivulis, Primorsk Prov., Siberia Orientalis. Legit. I. P. Popov.

Valve linear, with parallel margins and broad-rostrate ends. Median line robust, with distinct comma-shaped terminal fissures. Axial area broad, somewhat less than $\frac{1}{3}$ of the valve breadth. Central area a rectangular fascia, slightly dilated outwards. Costæ radiate in the middle, convergent at the ends, 9 in 0.01 mm, without longitudinal bands. Length, 0.059 mm; breadth, 0.01. Rare.

PINNULARIA DIVERGENS W. Smith.

Pinnularia divergens W. Smith, FR. HUSTEDT, Bacillar. (1930) 323, fig. 589.

Valve lanceolate, slightly triundulate, with broad subrostrate ends. Median line filiform, with large comma-shaped terminal fissures. Axial area linear, central suborbicular. Costæ divergent in the middle and convergent at the ends, 8 to 9 in 0.01 mm. Length, 0.107 mm; breadth, 0.018. Costæ more robust than in the type. Infrequent.

PINNULARIA DIVERGENS W. Smith var. **ELLIPTICA** Grunow. Plate 1, fig. 37.

Pinnularia divergens W. Smith var. *elliptica* Grunow, FR. HUSTEDT, Bacillar. (1930) 323, fig. 590.

Valve broad-elliptic. Central area a broad fascia, with distinct, marginal, dark, horsehoe-shaped areas. Length, 0.093 mm; breadth, 0.022. Costæ 8 in 0.01 mm. Infrequent.

PINNULARIA DIVERGENS W. Smith var. **UNDULATA** Heribaud and Peragallo. Plate 1, fig. 28.

Pinnularia divergens W. Smith var. *undulata* Heribaud and Peragallo, FR. HUSTEDT, Bacillar. (1930) 323, fig. 591.

Valve with triundulate margins and a transverse fascia widened outwards with distinct, dark, horseshoe-shaped areas. Length, 0.076 mm; breadth, 0.014. Costæ 9 to $9\frac{1}{2}$ in 0.01 mm. Infrequent.

PINNULARIA EPISCOPALIS Cleve. Plate 3, fig. 26.

Pinnularia episcopalis Cleve, FR. HUSTEDT, Bacillar. (1930) 323, fig. 592.

Valve robust, linear, with broad ends. Median line filiform, with large comma-shaped terminal fissures and central nodules

curved to one side. Axial area narrow-linear, central a broad fascia widened outwards. Costæ divergent in the middle and convergent at the ends, without longitudinal bands. Length, 0.127 to 0.2 mm; breadth, 0.034 to 0.04. Costæ 6 to 8 in 0.01 mm. Very common.

PINNULARIÆ TABELLARIÆ

PINNULARIA GIBBA Ehr. Plate 1, fig. 22.

Pinnularia gibba Ehr., FR. HUSTEDT, Bacillar. (1930) 327, fig. 600.

Valve linear-lanceolate, slightly attenuate towards the subcapitate ends. Median line filiform with large comma-shaped terminal fissures. Axial area dilated towards the middle, central area a broad rectangular fascia. Costæ slightly radiate in the middle, convergent at the ends. Length, 0.0459 mm; breadth, 0.0085. Costæ 10 to 11 in 0.01 mm. Common.

PINNULARIA GIBBA Ehr. var. LINEARIS Hustedt. Plate 3, fig. 1.

Pinnularia gibba Ehr. var. *linearis* FR. HUSTEDT, Bacillar. (1930) 327, fig. 604.

Valve narrow, linear, with obtuse, round ends. Length, 0.068 mm; breadth, 0.0068. Costæ 10 in 0.01 mm. Common.

PINNULARIA GIBBA Ehr. fo. POLYMORPHA fo. nov. Plate 1, figs. 3 and 4; Plate 2, figs. 7 and 9.

Differt a fo. subundulata Mayer area centralis fronte viza late transversa dilatata, pone-angusta transversa dilatata. Longis valvis 0.059 ad 0.098 mm; latis valvis 0.006 ad 0.01. Costis 9 ad 11 in 0.01 mm. Habit. in aquis stagnalis prope Lianchiho rivulis, Primorsk Prov., Siberia Orientalis. Legit I. P. Popov.

Valve linear, slightly triundulate, with attenuate ends. Axial and central areas on one side of the valve shorter than on the other. Length, 0.059 to 0.098 mm; breadth, 0.006 to 0.01. Costæ 9 to 11 in 0.01 mm. Common.

PINNULARIÆ BREVISTRIATÆ

PINNULARIA BREVICOSTATA Cleve. Plate 2, fig. 5.

Pinnularia brevicostata Cleve, FR. HUSTEDT, Bacillar. (1930) 329, 330, fig. 609.

Valve linear, slightly gibbous in the middle, ends round obtuse. Median line straight and robust. Axial area about $\frac{1}{3}$ of the valve breadth. Costæ interrupted in the middle. Length, 0.132 mm; breadth, 0.013. Costæ 8 in 0.01 mm. Longer than the type. Infrequent.

PINNULARIA ACROSPHAERIA Breb.

Pinnularia acrosphaeria Breb., FR. HUSTEDT, Bacillar. (1930) 330, fig. 610.

Valve linear, slightly triundulate. Axial area punctate. Length, 0.068 mm; breadth, 0.012. Rare. Reported from northern Manchuria.

PINNULARIÆ MAJORES

PINNULARIA MAJOR (Kütz.) Cleve var. LINEARIS Cleve.

Pinnularia major (Kütz.) Cleve var. *linearis* Cleve, PANTOCSEK, Fossile Bacillarien Ungarns (1903) 111, pl. 7, fig. 113.

Infrequent. Length, 0.204 mm; breadth, 0.027. Costæ 6 to 6½ in 0.01 mm.

PINNULARIA MAJOR (Kütz.) Cleve var. LINEARIS Cleve fo. NEGLECTA Mayer. Plate 1, fig. 16.

Pinnularia major (Kütz.) Cleve var. *linearis* Cleve fo. *neglecta* Mayer, FR. HUSTEDT, Bacillar. (1930) 331.

Valve linear, with broad-rounded ends. Median line straight, very robust, with lunate terminal fissures. Axial area about ⅛ of the valve breadth. Costæ almost parallel, very slightly radiate in the middle and convergent at the ends. Longitudinal band distinct. Length, 0.102 mm; breadth, 0.015. Costæ 6 in 0.01 mm. Common.

PINNULARIA VIRIDIS (Nitz.) Ehr. var. FALLAX Cleve. Plate 3, fig. 25.

Pinnularia viridis (Nitz.) Ehr. var. *fallax* Cleve, FR. HUSTEDT, Bacillar. (1930) 335; A. SCHMIDT, Atlas Diatom. (1876) pl. 43, fig. 24; pl. 45, figs. 10, 11.

Valve linear, with parallel margins and rounded ends. Median line complex. Axial area about ⅓ of the breadth of the valve. Central area interrupted to a fascia. Costæ almost parallel, 8 in 0.01 mm. Longitudinal band distinct. Length, 0.08 mm; breadth, 0.012. Striæ more robust than in the type. Infrequent.

PINNULARIA VIRIDIS (Nitz.) Ehr. var. ORIENTALIS var. nov. Plate 1, figs. 9 and 10; Plate 2, fig. 15.

Valvis linearis ad marginem parallelis, polis attenuatis rotundatis. Raphe plicata. Area axillaris sat dilatata, centralis rotundata. Costis in media valvarum parte radiantibus, apices versus convergentibus. Differt a typo valvis linearibus cum marginem parallelis, a var. intermedia Cleve area centralis rotundatis. Longis valvis, 0.059 ad 0.078 mm; latis valvis 0.011

ad 0.0136. Costis 6 ad 9 in 0.01 mm. Habit. in aquis stagnalis prope Lianchiho rivulis, Primorsk Prov., Siberia Orientalis. Legit I. P. Popov.

Valve linear, slightly attenuate at the rounded ends. Median line indistinct, complex. Axial area less than $\frac{1}{4}$ of the breadth of the valve. Central area broad, enlarged. Costæ radiate, convergent at the ends. Longitudinal bands distinct, broad. Length, 0.059 to 0.078 mm; breadth, 0.011 to 0.0136. Costæ 6 to 9 in 0.01 mm. Differs from the type in its linear valves with parallel margins, and from var. *intermedia* Cleve in its rounded central area. Very common.

PINNULARIA GENTILIS (Donk.) Cleve var. SIBIRICA Skvortzow. Plate 1, fig. 7.

Pinnularia gentilis (Donk.) Cleve var. *sibirica* SKVORTZOW, Diatoms collected by Dr. Y. Okada in Nippon I, pl. 2, fig. 2.

Valve linear, slightly gibbous in the middle and indistinctly attenuate toward the rounded ends. Length, 0.119 mm; breadth, 0.017. Costæ 9 to 7 in 0.01 mm. Common. Reported from Lake Kenon, Transbaikalia, Siberia, and from Nippon.

PINNULARIA NOBILIS Ehr. var. PARALLELA Skv. Plate 2, fig. 4.

Pinnularia nobilis Ehr. var. *parallela* SKVORTZOW, Neogene diatoms from environs of Gensan, Korea (1936) pl. 4, fig. 5.

Valve linear, robust, with parallel margins and broad-rounded ends. Median line distinct, complex. Axial area somewhat less than $\frac{1}{4}$ the breadth of the valve, narrow-linear. Central area slightly dilated. Costæ almost parallel, slightly convergent at the ends. Longitudinal band narrow. Length, 0.27 to 0.34 mm; breadth, 0.032 to 0.04. Costæ 4 to 6 in 0.01 mm. Common. Reported as a fossil from Korea. Recent specimens are larger than fossils.

PINNULARIA NOBILIS Ehr. var. DISTINCTA var. nov. Plate 1, fig. 5.

Differt a typo valvis raphe leniter plicata. Longis valvis 0.187 mm; latis 0.025. Costis 6 in 0.01 mm. Habit. in aquis stagnalis prope Lianchiho rivulis, Primorsk Prov., Siberia Orientalis. Legit I. P. Popov.

Differs from the type in the median line being very slightly complex, and from var. *fossilis* Pant. in its narrow longitudinal band having somewhat attenuate ends and a moderately complex median line. Length, 0.187 mm; breadth, 0.025. Costæ 6 in 0.01 mm. Common.

PINNULARIA STREPTORAPHE Cleve var. INTERRUPTA Skvortzow. Plate 2, fig. 1.

Pinnularia streptoraphe Cleve var. *interrupta* SKVORTZOW, Fresh-water diatoms from the environs of Vladivostok, pl. 1, figs. 1, 2.

Valve linear, slightly gibbous in the middle. Length, 0.171 mm; breadth, 0.023. Costæ 4 to 5 in 0.01 mm. Infrequent. Reported from the environs of Vladivostok.

PINNULARIA DISTINGUENDA Cleve var. **ASIATICA** Skvortzow. Plate 2, fig. 3.

Pinnularia distinguenda Cleve var. *asiatica* SKVORTZOW, Diatom flora of a mountain bog, Kaolingtze, Pin-Chiang-Sheng Province, Manchoukuo (1938) pl. 1, figs. 4, 14.

Valve linear, with distinct, round, ends. Median line complex. Axial and central area narrow-lanceolate. Striæ slightly radiate. Convergent at the ends. Length, 0.117 mm; breadth, 0.017. Costæ 6 in 0.01 mm. Common. Reported from northern Manchuria.

PINNULARIA DISTINGUENDA Cleve var. **SPHAGNALIS** var. nov. Plate 1, fig. 6.

Minor et angustior quam forma typica. Longis valvis 0.078 mm; latis valvis 0.01. Costis 8 in 0.01 mm. Habit. in aquis stagnalis prope Lianchiho, Primorsk Prov., Siberia Orientalis. Legit I. P. Popov.

Valve linear, with parallel margins and distinct produced ends. Median line complex with comma-shaped terminal fissures and robust central nodules. Axial area $\frac{1}{3}$ the breadth of the valve, central area enlarged. Costæ slightly radiate in the middle and convergent at the ends. Longitudinal band indistinct. Length, 0.078 mm; breadth, 0.01. Costæ 8 in 0.01 mm. Differs from the type in its small size and in its valves being only half as wide. Common.

PINNULARIA ISOSTAURON (Ehr.) Grun. var. **ORIENTALIS** var. nov. Plate 1, figs. 21 and 23.

Valvis linearis, prae formae angustior et attenuatis. Longis valvis 0.032 ad 0.035 mm; latis valvis 0.0054 ad 0.0065. Costis 12 ad 14 in 0.01 mm. Habit. in aquis stagnalis prope Lianchiho rivulis, Primorsk Prov., Siberia Orientalis. Legit I. P. Popov.

Valve linear, with parallel margins and slightly attenuate, rounded, ends. Median line indistinct, complex, with comma-shaped terminal fissures. Axial area about $\frac{1}{2}$ the breadth of valve. Central area a rectangular broad fascia. Costæ almost parallel. Length, 0.032 to 0.035 mm; breadth, 0.0054 to 0.0065. Costæ 12 to 14 in 0.01 mm. Differs from the type in its narrower valves and attenuate ends. Very common.

PINNULARIA SPHAGNICOLA sp. nov. Plate 2, fig. 2.

Valvis linearis cum marginem parallelis, polis rotundatis. Raphe directis plicatis, poris terminalis robustus curvatis, poris centralis dilatatis. Area axiliaris sat dilatata, centralis rotun-

data. Costis in media valvarum parte radiantibus apices versus convergentibus. Longis valvis 0.204 mm; latis valvis 0.0136 ad 0.014. Costis 6 in 0.01 mm. Habit. in aquis stagnalis prope Lianchiho rivulis, Primorsk Prov., Siberia Orientalis. Legit I. P. Popov.

Valve linear, with parallel margins and broad-rounded ends. Median line distinct complex. Axial area about $\frac{1}{3}$ of the valve breadth. Central area suborbiculate. Costæ divergent in the middle and convergent at the ends. Longitudinal band distinct and narrow. Length, 0.204 mm; breadth, 0.0136 to 0.014. Costæ 6 in 0.01 mm. A distinct species akin to *Pinnularia distinguenda* Cleve. Infrequent.

CYMBELLA AMPHIOXYS (Kütz.) Grun. var. ASIATICA var. nov. Plate 2, fig. 6.

Differt a typo valvis minoris angustis striis robustis. Longis valvis 0.04 mm; latis valvis 0.0042. Striis 12 in 0.01 mm. Habit. in aquis stagnalis prope Lianchiho rivulis, Primorsk Prov. Siberia Orientalis. Legit I. P. Popov.

Valve slightly curved, naviculiform, linear, and subrostrate ends. Isolated puncta distinct. Length, 0.04 mm; breadth, 0.0042. Striæ 12 in 0.01 mm. Differs from the type in its smaller size, narrower valve, and more robust striæ. Rare.

CYMBELLA TURGIDA (Greg.) Cleve.

Cymbella turgida (Greg.) Cleve, FR. HUSTEDT, Bacillar. (1930) 358, fig. 660.

Valve semielliptic. Length, 0.027 mm; breadth, 0.008. Striæ, ventral 7, dorsal 8 in 0.01 mm. Smaller than the type. Common. Reported from mountain bogs in northern Manchuria.

CYMBELLA TURGIDA (Greg.) Cleve var. MUSCOSA Skvortzow. Plate 2, fig. 26.

Cymbella turgida (Greg.) Cleve var. *muscosa* SKVORTZOW, Diatom flora of a mountain bog, Kaolingtze, Pin-Chiang-Sheng Province, Manchoukuo (1938) pl. 1, fig. 17.

Valve slightly arcuate, ventral side centrally undulate, dorsal arcuate, ends attenuate. Length, 0.032 mm; breadth, 0.068. Striæ 8 in 0.01 mm. Common. Reported from Kaolingtze, northern Manchuria.

CYMBELLA PERPUSILLA A. Cleve.

Cymbella perpusilla A. Cleve, FR. HUSTEDT, Bacillar. (1930) 361, fig. 666.

Valve linear-lanceolate, asymmetrical, with obtuse ends. Length, 0.02 mm; breadth, 0.0035. Striæ 10 in 0.01 mm. Infrequent.

CYMBELLA PERPUSILLA A. Cleve fo. ELONGATA fo. nov. Plate 3, fig. 17.

Differt a typo valvis elongatis semilanceolatis. Longis valvis 0.042 mm; latis valvis 0.005. Striis 8 in 0.01 mm. Habit. in aquis stagnalis prope Lianchiho rivulis, Primorsk Prov., Siberia Orientalis. Legit I. P. Popov.

Valve elongate, semilanceolate, with ventral side slightly undulate, dorsal moderately arcuate. Ends acute. Length, 0.042 mm; breadth, 0.005. Striæ 8 in 0.01 mm. Differs from the type in its elongate valves. Infrequent.

CYMBELLA GRACILIS (Rabh.) Cleve.

Cymbella gracilis (Rabh.) Cleve, FR. HUSTEDT, Bacillar. (1930) **359**, fig. 663.

Valve semielliptic-lanceolate. Ventral side straight, dorsal undulate. Length, 0.0306 mm; breadth, 0.005. Striæ 15 in 0.01 mm. Infrequent.

CYMBELLA GRACILIS (Rabh.) Cleve fo. SPHAGNICOLA fo. nov. Plate 1, fig. 13.

Differt a typo valvis angustior striis robustis. Longis valvis 0.029 ad 0.032 mm; latis valvis 0.005 ad 0.006. Striis 7 ad 9 in 0.01 mm. Habit. in aquis stagnalis prope Lianchiho rivulis, Primorsk Prov., Siberia Orientalis. Legit I. P. Popov.

Differs from the type in its narrower valves and more robust striæ. Abundant.

CYMBELLA CISTULA (Hemp.) Grunow.

Cymbella cistula (Hemp.) Grunow, FR. HUSTEDT, Bacillar. (1930) 363, fig. 676*a*.

Valve boat-shaped. Length, 0.105 mm; breadth, 0.02. Striæ 7 in 0.01 mm. At the ventral side of the central nodule are three puncta, ending the median striæ. Rare.

CYMBELLA HETEROPLEURA Ehr. var. MINOR Cleve.

Cymbella heteropleura Ehr. var. *minor* CLEVE, Synopsis of Naviculoid Diatoms (1894) 167.

Length, 0.076 mm; breadth, 0.0187. Striæ 10 to 11 in 0.01 mm. Rare.

CYMBELLA TUMIDA (Breb.) Van Heurck.

Cymbella tumida (Breb.) Van Heurck, FR. HUSTEDT, Bacillar. (1930) 366, fig. 677.

Valve arcuate with subrostrate, obtuse, ends. A stigma with a fine fissure below the central nodule. Length, 0.051 mm; breadth, 0.017. Very rare.

GOMPHONEMA LONGICEPS Ehr. var. MONTANA (Schum.) Cleve fo. MINUTA fo. nov. Plate 1, figs. 19 and 25; Plate 2, fig. 28.

Differt a var. montana valvis angustior et attenuatis. Longis valvis 0.022 ad 0.034 mm; latis valvis 0.0034 ad 0.0044. Striis 9 ad 12 in 0.01 mm. Habit. in aquis stagnalis prope Lianchiho rivulis, Primorsk Prov., Siberia Occidentalis. Legit I. P. Popov.

Valve clavate-triundulate, the apex broader than the basis. Ends subrostrate. Differs from var. *montana* (Schum.) Cleve in its more attenuate valves. Abundant.

HANTZSCHIA AMPHIOXYS (Ehr.) Grun. var. INTERMEDIA Grunow. Plate 3, fig. 8.

Hantzschia amphioxys (Ehr.) Grun. var. *intermedia* Grunow, A. SCHMIDT, Atlas Diatom. (1921) pl. 329, fig. 4.

Valve arcuate, with long, produced, ends. Length, 0.079 mm; breadth, 0.0085. Keel puncta 8, striæ 15 in 0.01 mm. Infrequent.

NITZSCHIA TRYBLIONELLA Hantz. var. DEBILIS (Arnott) A. Mayer. Plate 1, fig. 24.

Nitzschia tryblionella Hantz. var. *debilis* (Arnott) A. Mayer, FR. HUSTEDT, Bacillar. (1930) 400, fig. 759.

Valve elliptic-lanceolate, with cuneate-obtuse ends. Length, 0.022 mm; breadth, 0.0095. Costæ 12 in 0.01 mm. Very rare. Reported from rocks, Maoershan, northern Manchuria.

NITZSCHIA FRUSTULUM (Kütz.) Grun. var. PERMINUTA Grunow. Plate 1, fig. 12; Plate 2, fig. 12.

Nitzschia frustulum (Kütz.) Grun. var. *tenella* Grunow, VAN HEURCK, Synopsis (1881–1885) pl. 99, fig. 30.

Valve linear, with subrostrate ends. Length, 0.018 to 0.022 mm; breadth, 0.0025. Keel puncta 8 to 9, striæ 20 to 25 in 0.01 mm. Differs from the type in its more robust striæ. Common.

NITZSCHIA CAPITELLATA Hust. var. MONTANA Skvortzow. Plate 2, fig. 21.

Nitzschia capitellata Hust. var. *montana* SKVORTZOW, Diatom flora of a mountain bog, Kaolingtze, Pin-Chiang-Sheng Province, Manchoukuo (1938) pl. 1, fig. 24.

Valve linear, with parallel margin and attenuate-capitate ends. Length, 0.032 mm; breadth, 0.0034. Keel puncta 7, striæ 35 to 40 in 0.01 mm. Differs from *Nitzschia capitallata* Hust. in the more robust keel puncta. Infrequent. Reported from mountain bogs of northern Manchuria.

STENOPTERORIA INTERMEDIA (Lewis).

Stenopterobia intermedia (Lewis), FR. HUSTEDT, Bacillar. (1930) 428, 429, fig. 830.

Very rare. Reported from mountain bogs of northern Manchuria.

SURIRELLA ANGUSTATA Kützing.

Surirella angustata Kützing, FR. HUSTEDT, Bacillar. (1930) 435, figs. 844, 845.

Very rare. Reported from mountain bogs of northern Manchuria.

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ILLUSTRATIONS

PLATE 1

FIG. 1. *Neidium bisulcatum* (Lag.) Cleve fo. *undulata* O. Müll.
2. *Pinnularia subsolaris* (Grun.) Cleve var. *asiatica* var. nov.
FIGS. 3 and 4. *Pinnularia gibba* Ehr. fo. *polymorpha* fo. nov.
FIG. 5. *Pinnularia nobilis* Ehr. var. *distincta* var. nov.
6. *Pinnularia distinguenda* Ehr. var. *sphagnalis* var. nov.
7. *Pinnularia gentilis* (Donk.) Cleve var. *sibirica* Skv.
8. *Eunotia gracilis* (Ehr.) Rabh.
FIGS. 9 and 10. *Pinnularia viridis* (Nitz.) Ehr. var. *orientalis* var. nov.
FIG. 11. *Achnanthes linearis* W. Smith var. *pusilla* Grun.
12. *Nitzschia frustulum* (Kütz.) Grun. var. *perminuta* Grun.
13. *Cymbella gracilis* (Rabh.) Cleve fo. *sphagnicola* fo. nov.
14. *Eunotia arcus* Ehr. var. *bidens* Grun.
15. *Eunotia bigibba* Kütz. var. *pumila* Grun.
16. *Pinnularia major* (Kütz.) Cleve var. *linearis* Cleve fo. *neglecta* Mayer.
FIGS. 17 and 18. *Eunotia asiatica* sp. nov.
FIG. 19. *Gomphonema longiceps* Ehr. var. *montana* (Schum.) Cleve fo. *minuta* fo. nov.
20. *Navicula muscosa* sp. nov.
21. *Pinnularia isostauron* (Ehr.) Grun. var. *orientalis* var. nov.
22. *Pinnularia gibba* Ehr.
23. *Pinnularia isostauron* (Ehr.) Grun. var. *orientalis* var. nov.
24. *Nitzschia tryblionella* Hantz. var. *debilis* (Arnott) A. Mayer.
25. *Gomphonema longiceps* Ehr. var. *montana* (Schum.) Cleve fo. *minuta* fo. nov.
26. *Pinnularia subcapitata* Greg. fo. *tenua* fo. nov.
27. *Pinnularia mesolepta* (Ehr.) W. Smith fo. *angusta* Cleve.
28. *Pinnularia divergens* W. Smith var. *undulata* Herib. et Perag.
29. *Eunotia praerupta* Ehr. fo. *curta* Grun.
30. *Eunotia monodon* Ehr. var. *koreana* Skv. fo. *bidens* fo. nov.
31. *Eunotia veneris* (Kütz.) O. Müll.
32. *Achnanthes fragilis* Skv.
33. *Eunotia asiatica* sp. nov.
34. *Achnanthes fragilis* Skv.
35. *Eunotia asiatica* sp. nov. var. *interrupta* var. nov.
36. *Achnanthes linearis* W. Smith.
37. *Pinnularia divergens* W. Smith var. *elliptica* Grun.

PLATE 2

FIG. 1. *Pinnularia streptoraphe* Cleve var. *interrupta* Skv.
2. *Pinnularia sphagnicola* sp. nov.
3. *Pinnularia distinguenda* Cleve var. *asiatica* Skv.
4. *Pinnularia nobilis* Ehr. var. *parallela* Skv.
5. *Pinnularia brevicostata* Cleve.
6. *Cymbella amphioxys* (Kütz.) Grun. var. *asiatica* var. nov.

FIG. 7. *Pinnularia gibba* Ehr. fo. *polymorpha* fo. nov.
8. *Pinnularia appendiculata* (Agardh) Cleve.
9. *Pinnularia gibba* Ehr. fo. *polymorpha* fo. nov.
10. *Eunotia tenella* (Grun.) Hust.
11. *Eunotia tridentula* Ehr. var. *perminuta* Grun.
12. *Nitzschia frustulum* (Kütz.) Grun. var. *perminuta* Grun.
13. *Eunotia praerupta* Ehr. var. *laticeps* Grun.
14. *Eunotia tenella* (Grun.) Hust.
15. *Pinnularia viridis* (Nitz.) Ehr. var. *orientalis* var. nov.

FIGS. 16 and 17. *Eunotia arcus* Ehr. var. *bidens* Grun.

FIG. 18. *Eunotia arcus* Ehr. ?
19. *Eunotia pectinalis* (Kütz.) Rabh. var. *minor* (Kütz.) Rabh. fo. *impressa* (Ehr.) ?
20. *Eunotia arcus* Ehr.
21. *Nitzschia capitellata* Hust. var. *montana* Skv.
22. *Frustulia rhomboides* Ehr. var. *lineolata* Ehr.
23. *Eunotia monodon* Ehr. var. *koreana* Skv. fo. *bidens* fo. nov.
24. *Pinnularia divergentissima* (Grun.) Cleve var. *lata* var. nov.
25. *Navicula ignota* Krasske.
26. *Cymbella turgida* (Greg.) Cleve var. *muscosa* Skv.
27. *Eunotia elegans* Oestrup.
28. *Gomphonema longiceps* Ehr. var. *montana* (Schum.) Cleve fo. *minuta* fo. nov.
29. *Navicula cincta* (Ehr.) Kütz. fo. *sphagnicola* fo. nov.

PLATE 3

FIG. 1. *Pinnularia gibba* Ehr. var. *linearis* Hust.
2. *Eunotia monodon* Ehr. var. *koreana* Skv.

FIGS. 3 and 4. *Eunotia praerupta* Ehr.

FIG. 5. *Eunotia papilio* Ehr.
6. *Eunotia praerupta* Ehr. var. *bidens* Grun.
7. *Pinnularia karelica* Cleve var. *subcapitata* var. nov.
8. *Hantzschia amphioxys* (Ehr.) Grun. var. *intermedia* Grun.
9. *Eunotia kocheliensis* O. Müll.
10. *Eunotia praerupta* Ehr.
11. *Eunotia praerupta* Ehr. var. *inflata* Grun. fo. *curta* Grun.
12. *Eunotia kocheliensis* O. Müll.
13. *Eunotia monodon* Ehr. var. *koreana* Skv. fo. *bidens* fo. nov.
14. *Eunotia bigibba* Kütz. var. *pumila* Grun.
15. *Eunotia praerupta* Ehr. var. *inflata* Grun.
16. *Navicula sohrensis* Krasske var. *parallela* var. nov.
17. *Cymbella perpusilla* A. Cleve fo. *elongata* fo. nov.
18. *Eunotia praerupta* Ehr.
19. *Eunotia bigibba* Kütz. var. *pumila* Grun.
20. *Caloneis silicula* (Ehr.) Cleve var. *alpina* Cleve.
21. *Eunotia praerupta* Ehr. var. *bidens* Grun.
22. *Eunotia bigibba* Kütz. var. *pumila* Grun.
23. *Pinnularia legumen* Ehr.
24. *Caloneis sphagnicola* Skv.
25. *Pinnularia viridis* (Nitz.) Ehr. var. *fallax* Cleve.
26. *Pinnularia episcopalis* Cleve.

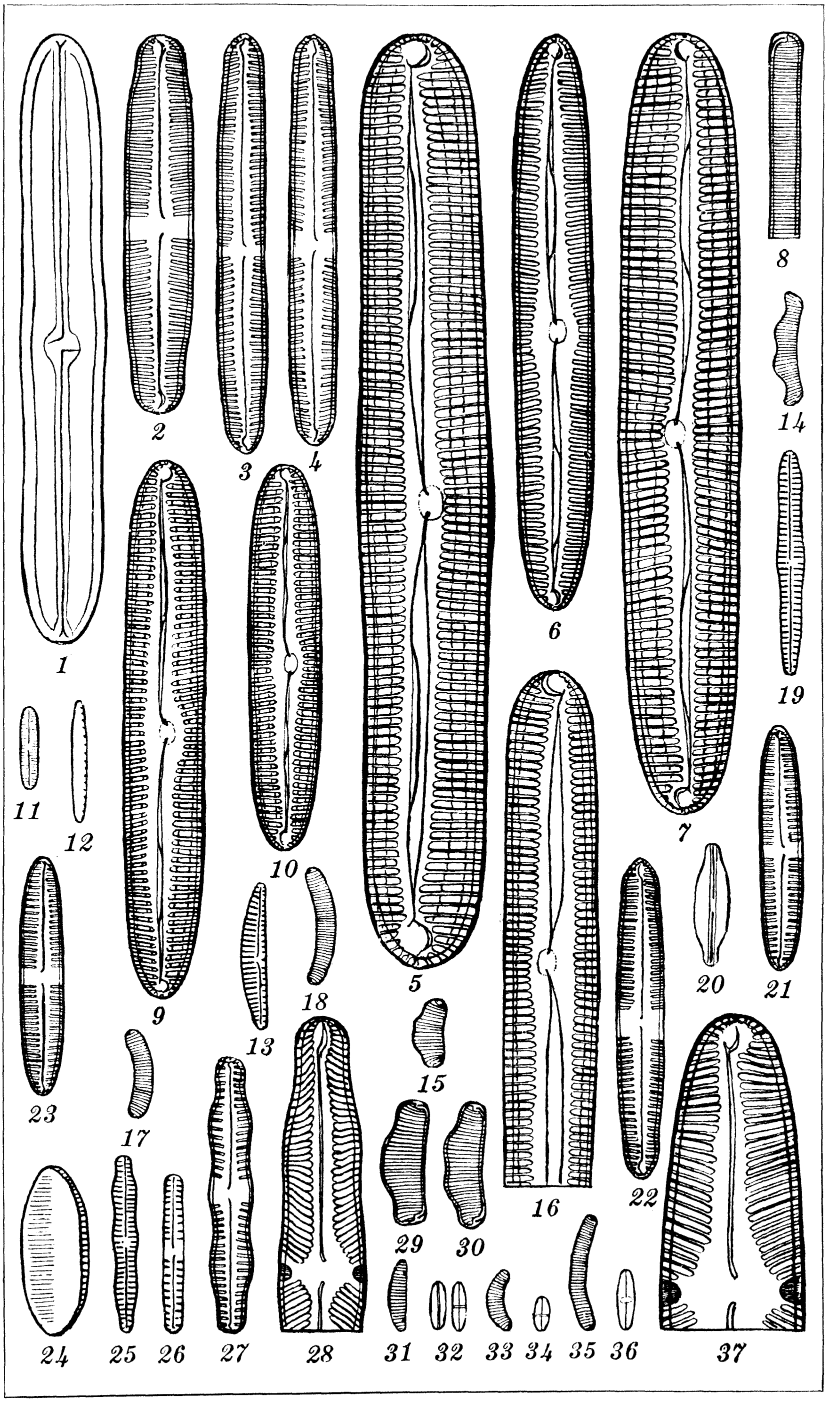
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PLATE 1.

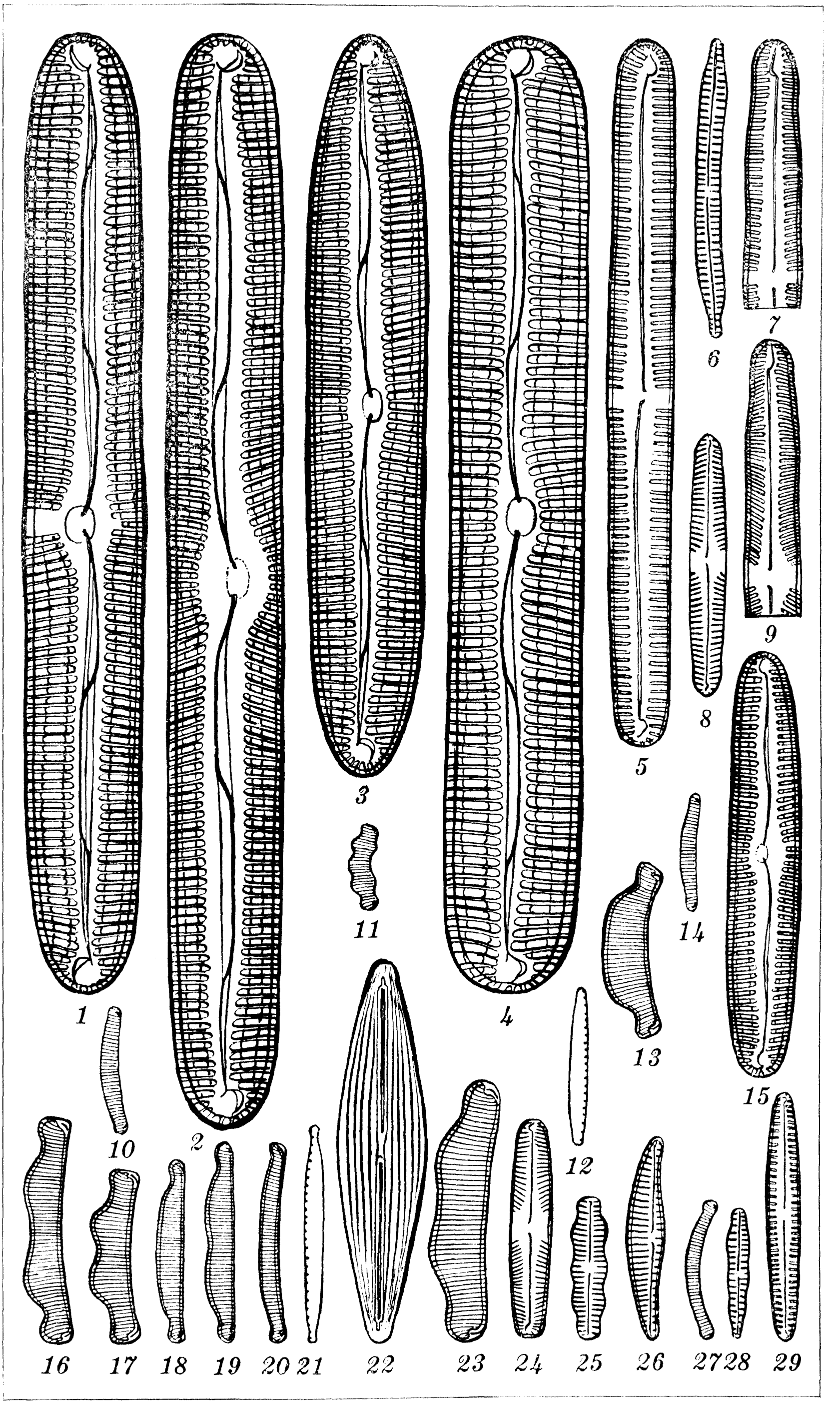

PLATE 2.

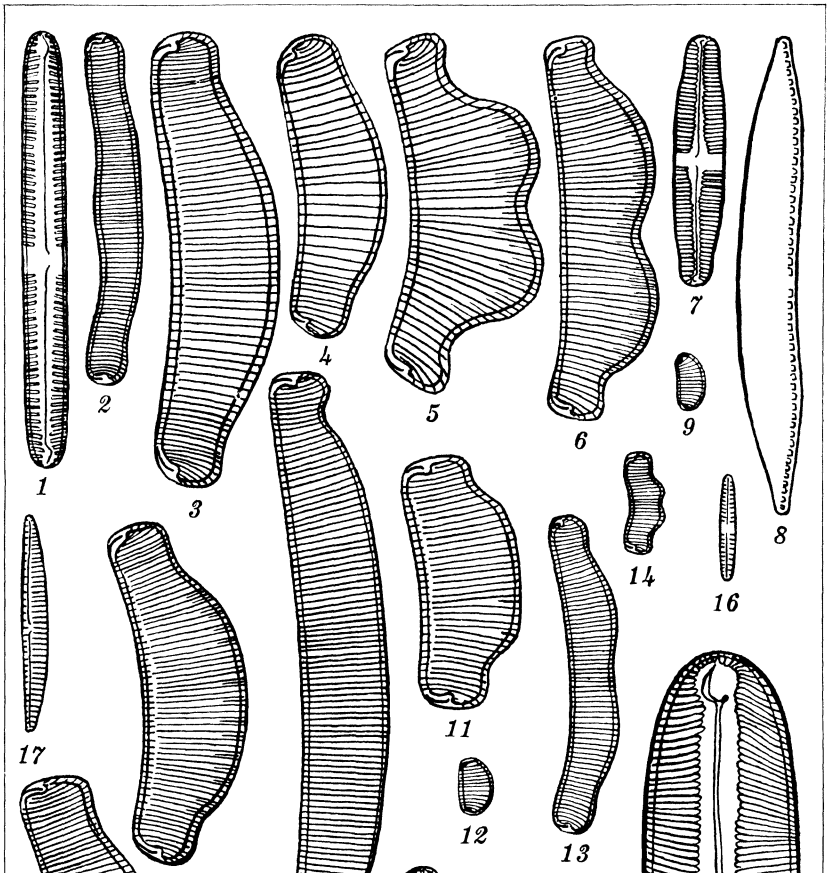

PLATE 3.

THE LITTORAL PAGURIDEA IN THE COLLECTION OF THE UNIVERSITY OF THE PHILIPPINES

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TWO PLATES

The present paper is an attempt to gather together the descriptions of Philippine pagurids scattered in different papers. Included are 30 species and 3 varieties of littoral hermit crabs, of which 2 varieties are new. The species and varieties belong to the following 8 genera: *Cœnobita,* 4 species and a new variety; *Birgus,* one species; *Clibanarius,* 9 species of which a variety is new; *Pagurus,* 9 species; *Aniculus,* one species; *Diogenes,* 2 species; *Calcinus,* 4 species and a variety; and *Eupagurus,* 1 species.

The genera listed above are represented by species that are littoral and even almost terrestial in habit. At Puerto Galera members of *Eupagurus* and *Pagurus* were neither observed to go beyond the shore line nor above the water. *Clibanarius, Calcinus,* and *Diogenes* are littoral or partly terrestial. On the other hand, *Cœnobita* and *Birgus* are almost terrestial and only partially littoral. According to reports, members of the genus *Aniculus* are fossorial although they live in shells.

In the preparation of this paper I am indebted to past members of the Department of Zoölogy, principally to L. D. Griffin, R. P. Cowles, S. F. Light, A. L. Day, and E. Estampador, who have enlarged the pagurid collection of the University of the Philippines. The writer is especially grateful to Dr. H. A. Roxas for constructive criticism and for going over this paper.

THE PAGURIDEA

The hermit crabs belong to the *Paguridea,* a tribe of Anomura, which is a subdivision of the order Decapoda. The Paguridea nearly always have an asymmetrical, imperfectly segmented abdomen which is either soft and twisted or bent under the thorax. Usually the sixth somite and the telson are fully calcified. The terga of the other somites are merely marked by widely separated chitinous plates in the membrane covering the dorsal

surface. The only exception is *Birgus*, which has a symmetrical abdomen and well-calcified terga. The rostrum is generally present but may also be obsolete or absent. The tail fan is atypical and the uropod, when present, is fitted for holding the body in hollow objects, such as shells of snails.

The Paguridea include four families: namely, the Pylochelidæ, the Paguridæ, the Cœnobitidæ, and the Lithodidæ. Of the above families only certain Paguridæ and Cœnobitidæ are commonly found in the Philippines. The Pylochelidæ are exclusively deep-water forms, while the Lithodidæ inhabit shallow waters of the Arctic and Antarctic zones and deep waters of the temperate and tropical regions.

Key to the families of the Paguridea.

a[1]. Uropod of telson present; last pair of legs shorter than preceding pair.
- *b*[1]. Pleon straight and symmetrical; provided with five paired symmetrical appendages in addition to the uropods. PYLOCHELIDÆ Spence Bate.
- *b*[2]. Pleon either coiled or spiral; paired appendages not present in all abdominal segments.
  - *c*[1]. Flagella of first antennæ end in a filament; peduncle of first antennæ shorter than carapace.................................. PAGURIDÆ Dana.
  - *c*[2]. Flagella of first antennæ end bluntly; peduncle of first antennæ either as long as or longer than carapace.... COENOBITIDÆ Dana.

a[2]. Uropod of telson absent; last pair of legs as well developed as the preceding pair .... LITHODIDÆ Dana.

Family PAGURIDÆ Dana

Paguridæ DANA, U. S. Expl. Exped. Crust. pt. 1 (1852) 435.

Paguroidæ BOAS, Vidensk. Selsk. 6; RAEKKE, naturuid. og. math. Afd. 1 2 (1880) 189.

Parapaguridæ SMITH, Bull. Mus. Comp. Zoöl. Harvard 10 (1883) 20; HENDERSON, Challenger Anomura 85; T. R. R. STEBBING, Hist. Crust. 166.

Paguridæ STEBBING, Hist. Crust. (1893) 159.

Paguridæ ALCOCK, Cat. Ind. Crust. 2 Fasc. 1 (1905) 21.

Carapace generally elongate; gastric region well calcified. Rostrum prominent, at times either rudimentary or absent. Flagella often short. Ophthalmic scales and antennal acicles usually large. Abdomen membranous, soft, twisted. Chelipeds generally bulky, left usually larger, although the two may be equal, or rarely the right larger. Walking legs long, usually exceeding length of chelipeds. Penultimate and last pairs slender, either subcheliform or cheliform. Abdominal appendages unpaired, usually on left only; paired in some instances. Left member of telson more developed. Female genital openings

on ventral base of third pair of legs; male genital openings on coxæ of last pair of legs.

The family Paguridæ is subdivided into two subfamilies; namely, Pagurinæ and Eupagurinæ. The subfamily Pagurinæ includes the following eleven genera: *Paguropsis, Paguristes, Clibanarius, Isocheles,* (synonymous to *Holopagurus*), *Cancellus, Petrochirus, Pagurus, Aniculus, Diogenes, Calcinus,* and *Troglopagurus.* Of this number only five have been found represented in the Philippines; namely, *Clibanarius, Pagurus, Aniculus, Diogenes,* and *Calcinus.* Of the subfamily *Eupagurinæ* there are eighteen genera, of which only one, *Eupagurus,* is represented in the Philippines.

Key to the Philippine genera of littoral Paguridæ.

a[1]. Third pair of maxillipeds very close at base........ PAGURINÆ Ortmann.
- *b*[1]. Chelipeds equal or slightly unequal; their dactylopodites close and open horizontally .... *Clibanarius* Dana.
- *b*[2]. Chelipeds subequal, the left generally much larger; their dactylopodites close and open obliquely.
  - *c*[1]. Finger apices dark and horny.
    - *d*[1]. Chelipeds generally subequal, the left much larger; chelipeds and legs not broken into series of scutella........ *Pagurus* Dana.
    - *d*[2]. Chelipeds only slightly subequal; chelipeds and legs broken into a series of scutella........ *Aniculus* Dana.
  - *c*[2]. Finger apices white or calcareous.
    - *d*[1]. Rostrum absent, its place taken by a rostriform process wedged in between the ophthalmic scales; chelipeds rough and not porcellanous, with no bright colors........ *Diogenes* Dana.
    - *d*[2]. Rostrum present; rostriform process absent, chelipeds and legs smooth and porcellanous, often with bright colors. *Calcinus* Dana.

a[2]. Third pair of maxillipeds widely parted at base. EUPAGURINÆ Ortmann. Chelipeds unequal, the right vastly larger; fingers calcareous and moving horziontally; abdomen soft, membranous, and twisted on itself........ *Eupagurus* Brandt.

Genus CLIBANARIUS Dana

Clibanarius DANA, U. S. Expl. Exped. Crust. 2 (1852) 461.
Clibanarius HENDERSON, Voy. H. M. S. Challenger 27 (1888) 60.
Clibanarius STEBBING, Hist. Crust. (1893) 160.
Clibanarius MILNE-EDWARDS and BOUVIER, Mem. Mus. Comp. Zoöl. Harvard XIV 3 (1893) 156.
Clibanarius ALCOCK, Cat. Ind. Dec. Crust. 2 Fasc. 1 (1905) 40.

Carapace strongly calcified except branchial region; rostral projection small but distinct. Ocular peduncle slender, with moderately large basal scales lying very close together. Antennal acicle short; flagellum long and nude. Third maxillipeds

very close together at base. Chelipeds either equal or subequal; configuration in the two similar. Fingers moving horizontally with corneous apices and greatly concave inner surface. Crawling legs often with color markings; penultimate legs imperfectly chelate; the last chelate. Abdomen membranous, twisted, well developed. Abdominal appendages of both sexes dichotomous, located on left of second, third, fourth, and fifth somites. Telson asymmetrical, left more developed. Eight species are recorded; one variety, *C. corallinus* var. *spinatus*, is new.

Key to the Philippine species of Clibanarius.

a^1. Propodus of third left leg equal to or longer than dactylus.
- b^1. Propodus of third left leg distinctly longer than dactylus; upper surface of propodus separated from flat lateral plane by a fairly well developed crest.
  - c^1. Carapace decidedly elongated; chelipeds and legs pilose, especially outer surface of propodus of third left leg.
    - d^1. Ischiopodite of chelipeds without strong tooth on ventral side. *C. corallinus* Milne-Edwards.
    - d^2. Ischiopodite of cheliped with strong tooth on ventral side. *C. corallinus* var. *spinatus* var. nov.
  - c^2. Carapace slightly elongated; chelipeds and legs scarcely pilose; exposed surface of each leg with a white stripe; distal end of each propodus of legs without colored ring around it. *C. antillensis* Stimpson.
- b^2. Propodus of third left leg equal to the length of its dactylus; upper surface of propodus more or less rounded.
  - c^1. Gastric region of carapace, chelipeds, and legs blotched with numerous white spots on a brick-red ground color; dactylus of legs only compressed.................... *C. cruentatus* Milne-Edwards.
  - c^2. Gastric region of carapace, chelipeds, and legs without spotting, instead with reddish orange and white stripes; propodus of legs remarkably flattened below.............. *C. eurysternus* Hilgendorf.

a^2. Propodus of third left leg decidedly shorter than dactylus.
- b^1. Antennular peduncle longer than ocular stalk.
  - c^1. Inferior axial border of merus of chelipeds merely serrulate. *C. clibanarius* (Herbst).
  - c^2. Inferior axial border of merus of chelipeds provided with a strong tooth .... *C. infraspinatus* Hilgendorf.
- b^2. Antennular peduncle of same length as ocular stalk.
  - c^1. Ocular stalk reaching only front border of carapace.
    - d^1. Exposed surface of legs with several stripes. *C. striolatus* Dana.
    - d^2. Exposed surface of each leg with only one stripe. *C. sclopetarius* (Herbst).
  - c^2. Ocular stalk exceeding length of front border of carapace. *C. padavensis* de Man.

1. CLIBANARIUS CORALLINUS (Milne-Edwards). Plate 1, fig. 11.

Pagurus corallinus MILNE-EDWARDS, Ann. Sci. Nat. Zoöl. (3) 10 (1848) 63.

Clibanarius obesomanus (*? corallinus*) DANA, U. S. Expl. Exp. Crust. pt. 1 (1852) 468.

Clibanarius corallinus DE MAN, Archiv. f. Naturg. 53 (1887) 447; ORTMANN, Zool. Jahrb. Syst. 6 (1892) 292.

Clibanarius corallinus ALCOCK, Cat. Ind. Decapod. Crust. 2 Fasc. 1 (1905) 48, pl. 5, fig. 1.

Dactylus of third leg shorter than propodus; both flat and heavily set with bristles. Carapace broadened posteriorly, its greatest breadth across gill region about three-fifths its length at sagittal plane; dorsolateral borders of gastric region covered with clusters of moderately long brownish hairs. Setæ of same color covering entire length of ocular peduncle and pedicels of first and second antennæ; rostrum small, hardly exceeding antennal angles of carapace. Ocular stalk slender and longer than front border of carapace, exceeding antennular peduncle by a length equal to its cornea; ophthalmic scales triangular and serrulate, lying very close together. Acicle short and heavily setose especially on lateral distal portion, reaching only base of last segment of antennal peduncle; flagellum long and naked. Chelipeds slightly subequal but similar, more or less heavily hirsute; merus laterally compressed, with a triangular cross section; sharp dorsal border and outer lower surface planted with hair tufts; axial edge serrated. Both dorsal and outer surface of carpus, propodus, and fingers made rugged by numerous conical corneous-tipped tubercles, each with its own tuft of bristles. Hands short and contracted, globular below; fingers dwarfed and broad with corneous tips. Walking legs heavily setose with hair tufts; longer than chelipeds, second pair longest; propodus of second walking leg about twice dactylus; third pair of legs remarkably shorter than second, with propodus and dactylus on left side flattened and very setose.

Previously recorded from Nicobars, Tahiti, Liu-Kiu Islands, New Guinea, Fiji Islands, Malay Archipelago, Andamans, Reef of Coco Islands, and Wake Island.

This species is represented in the University of the Philippines Zoölogical Collection by 8 specimens (0–345 and 0–461) collected from Manila Bay and Medio Islands, Mindoro Province.

2. CLIBANARIUS CORALLINUS var. SPINATUS var. nov.

This variety differs from the type species in the following particulars: (*a*) A strong tooth present on inferior outer border

of ischiopodite of chelipeds; (*b*) propodus of third left leg more distinctly subcarinate on dorsal superior outer border; lower border of carina fringed with tufts of long hairs resembling a curtain; (*c*) body less setose. This new variety is described from three specimens with accession No. 0–552 in the University of the Philippines Collection collected from Puerto Galera, Mindoro Province, by Cowles.

3. **CLIBANARIUS ANTILLENSIS** Stimpson.

Clibanarius antillensis STIMPSON, Ann. Lyc. Nat. Hist. 7 (1859) 85; BENEDICT, Bull. U. S. Fish. Comm. 20 (1900) 142, pl. 6, fig. 1.

Ocular stalk equal to length of front border of carapace; acicle merely a projecting spinule; dactylus of third left leg shorter than propodus of same leg; white longitudinal stripe on propodus and dactylus of legs oftentimes continued to carpus and merus.

Carapace elongate, its few bristles confined to anterolateral margins and gastric region immediately behind cervical groove; gastric region with numerous small deep pits; rostrum small, in the form of a strong spinule projecting between bases of ophthalmic scales. Eyestalk slender, reaching front border of carapace but slightly exceeding antennular peduncle; cornea nondilated; ophthalmic scales rather approximated, short but broad, their distal outer margin serrate with three or four spinules. Acicle small and spinose, reaching base of last segment of antennal peduncle. Chelipeds equal and similar; merus on dorsal side scabrous; lower inner margin serrulate; carpus short and rather rough, its upper border spinose, with tufts of stiff brownish hairs; hands short, somewhat globular below, spinose; white conical spines present on dorsal surface; stiff bristles arising from base of spines. Ambulatory legs longer than chelipeds; carpi armed with single spine on dorsal margin at distal end; propodus and dactylus of third left leg triangular, its dorsal surface separated from lateral by an overhanging subcarinated crest; dactylus of third left leg shorter than its propodus; merus, carpus, propodus, and dactylus of legs with white longitudinal stripe on external surface; at times stripe also present on inner surface.

This species has been so far reported only from the Antilles and Puerto Rico.

The University of the Philippines collection of about 150 specimens was obtained from Puerto Galera, Mindoro Province, and Taytay, Palawan Province.

4. CLIBANARIUS CRUENTATUS (Milne-Edwards). Plate 1, fig. 8.

Pagurus cruentatus MILNE-EDWARDS, Ann. Sci. Nat. Zoöl. (3) 10 (1848) 62.

Clibanarius cruentatus DE MAN, Journ. Linn. Soc. Zoöl. 22 (1888) 250; WHITELEGGE, Mem. Austral. Mus. 3 (1897) 143; ALCOCK, Cat. Ind. Decapod. Crust. 2 Fasc. 1 (1905) 50.

Carapace, legs, acicles, and chelipeds with reddish background ocellated with whitish spots. This species is the only one of the genus showing this character. Cephalothorax slightly flattened, making branchial region look somewhat dilated sideways. Chelipeds alike, not much stouter than legs; dorsal surface of hands studded with strong conical tubercles.

Gastric region of carapace, acicles, legs, bases of first and second antennæ, and chelipeds with many whitish spots on brick-red background. Rostrum triangular, acute, prominent, projecting up to bases of ophthalmic scales. Ocular peduncle very long and slender, slightly longer than front border of carapace and equalling length of antennular peduncle. Two chelipeds alike in every respect; superior distal border with prominent spine directed anteriorly; dorsal anterior margin of hand studded with prominent sharp-pointed, dark-tipped tubercles; dorsal surface of fixed finger similarly studded. Chelipeds sparsely setose. Crawling legs not rugged or tuberculose, sparsely setose. Only armature of legs is black-tipped spine on superior distal margin of carpopodite; right members of crawling legs longer than left, both legs surpassing tips of chelipeds; dactylopodites of second pair of legs as long as propodites.

Reported from New Zealand, Mergui, Gulf of Bengal, Funafuti, and Indian Archipelago.

Philippine materials were collected from Taytay, Palawan Province, and Puerto Galera, Mindoro Province.

Color in alcohol either uniform white or yellowish orange; in both cases the white patches on the legs including chelipeds and gastric region of carapace on a brick-red ground color are retained.

5. CLIBANARIUS EURYSTERNUS Hilgendorf. Plate 1, fig. 9.

Pagurus (Clibanarius) eurysternus HILGENDORF, Monatsb. Akad. d. Wiss. Berlin (1878) 822, pl. 3, figs. 9, 10.

Clibanarius eurysternus DE MAN, Archiv. f. Naturg. 53 (1887) 447; NOBILI, Ann. Mus. Civ. d. Geneva 40 (1899).

Cephalothorax and basal segments of chelipeds and legs depressed; carapace striated with color markings; outer surface

of legs similarly striped; chelipeds similar and equal; dactylus of legs remarkably flattened from below.

Carapace very much compressed; gastric region setose on anterolateral angles. Six longitudinal reddish brown stripes on dorsal surface, two median and continuous, two lateroanterior, and two broken lateroposterior flanking the two median ones. Rostrum exceeding antennal angles of carapace. Ocular stalk with alternate reddish brown and yellowish white longitudinal stripes; equal to anterior border of carapace, noticeably longer than antennular peduncle. Ophthalmic scales approximated, broadly triangular and spinose at free edges. Antennal acicle stout, setose, spinose on top, distinctly overlapping base of last segment of peduncle. Chelipeds and legs including fourth and fifth pairs striped similar to eyestalks. Chelipeds similar and equal, slightly stouter than legs, equal to or slightly longer than carapace. Merus unarmed except for two spines and a tubercle on distal outer lower margin, transversely rugate on blunt dorsal edge, each rugus fringed with yellowish bristles; carpus with a strong spine on distal inner border. Hands and fingers on dorsal surface studded with conical corneous-tipped spines with a cluster of yellowish bristles arising from base of each; fingers when closed meet only at tips. Legs much longer than chelipeds, right legs longer than left. Carpus of legs with sharply pointed, corneous-tipped spine on inner dorsal and distal border; few spines of similar nature also present on distal inferior outer margin of carpus of left leg only. Propodus and dactylus of third legs equal in length, both compressed from below; dactylopodite and propodite of third left leg only provided with spines on superior outer cristiform overhanging borders. Setæ well developed, ornamenting all segments of legs. Abdominal appendages, tail fan not included, four in number, occupying segments 2 to 5; plumose and dichotomously unequal in both sexes.

Known from Mozambique, Malay Archipelago, and Malesia.

Local materials (0–345 and 0–457) obtained from Manila Bay and Puerto Galera, Mindoro Province.

6. CLIBANARIUS CLIBANARIUS (Herbst). Plate 1, fig. 4.

Cancer clibanarius HERBST, Krabben u. Krebse **2** (1791) 20, pl. **23**, fig. 1.

Pagurus clibanarius LATREILLE, Hist. Nat. Crust. **6** (1803) 167; OLIVIER, Encycl. Method. **8** (1811) 647.

Clibanarius vulgaris DANA, U. S. Expl. Exp. Crust. pt. 1 (1852) 462; MIERS, Ann. & Mag. Nat. Hist. (5) **5** (1880) 375; DE MAN, Notes Leyden Mus. 12 (1890) 112.

Clibanarius clibanarius HILGENDORF, MB. K. Akad. Berlin (1878) 820; ALCOCK, Cat. Ind. Decapod. Crust. 2 Fasc. 1 (1905) 43, pl. 4, fig. 1.

Eyestalks long and slender, exceeding front border of carapace; antennal acicle spiny, long, and extending well beyond base of last segment of peduncle; chelipeds similar and equal, hands armed with strong spines.

Carapace expanded posteriorly, with tufts of hairs more or less concentrated on proximal portion of branchial region, on cardiac region immediately behind cervical groove, and along anterolateral borders; rostral projection small, triangular, not much more prominent than antennal angles of carapace. Ocular stalk slender and longer than anterior border of carapace but exceeded by antennules; eyestalks and peduncle of both antennæ hirsute; basal scales small, close together, squamiform at base and acute distally, with free spinulate edges. Acicle spiny, long, extending well beyond base of last segment of antennal peduncle. Chelipeds alike, much more massive than walking legs; merus elegantly serrulate at lower inner margin; hand and carpus with strong spine on superior inner border and with closely set conical tubercles on dorsal surface; fingers meeting only at tips. Walking legs more or less granular, all longer than chelipeds; dactyli longer than propodites and much more setose than other segments of legs.

Previously reported from Hongkong, Bay of Bengal, Penang, Pondicherry, Singapore, and Borneo.

Local materials (0–1241) were obtained from Taytay, Palawan Province. Others (0–1738) have no exact locality record.

7. **CLIBANARIUS INFRASPINATUS** Hilgendorf. Plate 2, fig 4.

Clibanarius infraspinatus HILGENDORF, in v. d. Decken's Reisen Ost-Afric. (1) 3 (1869) 97; ORTMANN, Jahrb. Syst. Zool. 6 (1892) 290; HENDERSON, Trans. Linn. Soc. Zoöl. (2) 5 (1893) 423.

Clibanarius vulgaris DE MAN, Notes on Leyden Mus. (1890) 112.

Resembles *C. clibanarius* in many ways; differs from this species in having a strong blunt spine at inferior border of meropodite of each cheliped and in having more distinct longitudinal striolation of legs and ocular peduncles.

Known from Singapore, Mergui, Bay of Bengal, Sydney, Red Sea, and Tavoy.

University of the Philippines collections (0–151, 0–276, 0–1241 and 0–1398) were obtained from Manila market; Mariveles, Ba-

taan Province; Taytay, Palawan Province; and from Puerto Galera, Mindoro Province.

8. **CLIBANARIUS STRIOLATUS** Dana. Plate 1, fig. 1.

Clibanarius striolatus DANA, U. S. Expl. Exped. Crust. 1 (1852) 463, pl. 24, figs. 3*a-e*; HELLER, Novara Crust. (1865) 89; DE MAN, Archiv. f. Naturg. 53 (1887) 445; ALCOCK, Cat. Ind. Decapod Crust. 2 Fasc. 1 (1905) 46, pl. 4, fig. 7.

Ocular peduncle short and stout, equal to front border of carapace; rostrum short; hands so contracted as to become short and more or less globular.

This species resembles *C. padavensis* in many ways. It differs from the latter with regards to the following: (*a*) rostral projection not so prominent and distinct, not even more prominent than antennal angles of carapace, much less reaching base of basal scales of ocular peduncle; (*b*) eyestalk contracted anteroposteriorly, thicker and shorter, only equalling front border of carapace; cornea correspondingly increased in size; (*c*) hands, like ocular stalk, affected by same contraction, being more massive and shorter; carpus with a more rugged surface and with more bristles; (*d*) dactylopodite of third left leg not as long as that of *C. padavensis.*

Previously reported from Nicobars, Tahiti, Seychelles Islands, Liu-Kiu Islands, Australia, Queensland, Tongatabu, Fiji, Malay Archipelago, Karachi, Mergui, and Persian Gulf.

The specimens in the University of the Philippines Zoölogical Collection (0–1241 and 0–1318) were all obtained from Taytay, Palawan Province.

9. **CLIBANARIUS SCLOPETARIUS** (Herbst). Plate 1, fig. 6.

Cancer sclopetarius HERBST, Krabben u. Krebse 2 (1796) 23, pl. 23, fig. 3.

Clibanarius sclopetarius BENEDICT, Bull. U. S. Fish. Comm. 22 (1900) 142.

Pagurus tuberculosus MILNE-EDWARDS, Hist. Nat. Crust. 2 (1837) 229.

Carapace with many slightly elevated platelike granules; dactylus of third left leg longer than propodus; all crawling legs with one longitudinal stripe on external surface of all segments.

Carapace elongate, sparsely setose, with bristles more or less concentrated along anterolateral margins; gastric region deeply punctate, with low scattered squamiform granules; postfrontal suture very prominent, continuous with triangular depression that follows for some distance projection of round-tipped ros-

trum. Eyestalk shorter than front border of carapace, equal to antennular peduncle; eyes nondilated; ophthalmic scale broadly ovate, with a terminal white spine, parted at base but approximated distally. Antennal acicle short, reaching only to more than half penultimate segment of peduncle; inner edge spinose. Chelipeds subequal, right larger; merus, carpus, and hand granulose, granules tending to become laminar tubercles towards upper margin; bristles few, stiff, yellowish, confined on dorsal margin and on underarea of merus, becoming thicker towards extremities; fingers tuberculose, studded with stiff bristle tufts; tips black. Crawling legs very long, exceeding tip of chelipeds, unarmed, except for few tufts of bristles from merus to extremity and for somewhat elevated squamiform granules planted here and there on ischiopodites and meropodites; external surface of legs with longitudinal stripe; dactylus of third left leg subcylindrical, slightly curved, with black tip, and longer than propodus of same leg.

The writer doubts the position of this species. Our specimens partly agree with *Cancer sclopetarius* Herbst, in that the olive-green color mentioned by Benedict and the longitudinal stripe of reddish orange or dull brown on the external surface of crawling legs are retained. Milne-Edwards mentioned that in *Pagurus tuberculosus* the chelipeds are merely granulose, a character also true in the species under study. However, Milne-Edwards did not mention squamiform granules such as those found on carapace and legs of our specimens. Milne-Edwards remarked that *Cancer sclopetarius* Herbst is merely the young of his *P. tuberculosus.*

Our specimens are provisionally identified as *C. sclopetarius.*

Reported from the Antilles and Puerto Rico.

University of the Philippines zoölogical materials (0–459, 0–1241, 0–1900, and 0–1902), composed of 36 specimens, were collected from Puerto Galera, Mindoro Province, and Taytay, Palawan Province.

10. CLIBANARIUS PADAVENSIS de Man. Plate 1, fig. 5.

Clibanarius padavensis DE MAN, Journ. Linn. Soc. Zoöl. 22 (1888) 242, pl. 24, fig. 1; HENDERSON, Journ. Asiat. Soc. Bengal 2 (1896) 520; ALCOCK, Cat. Ind. Decapod Crust. 2 Fasc. 1 (1905) 44, pl. 4, fig. 2.

Eyestalk exceeding length of front border of carapace; chelipeds alike in every detail; dactylus of third left leg very much longer than its propodite; stripes on legs longitudinal.

Carapace broadened posteriorly, more fine bristles on dorsolateral margins of gastric region than on lateral sides; rostrum moderate but with tip as long as or exceeding somewhat base of ophthalmic scale. Ocular stalk about same length as antennular pedicel but distinctly longer than front border of carapace; eyes small and subreniform; ophthalmic scales very close together, spinose on their free border. Antennal acicle hairy, short, hardly reaching base of last segment of peduncle. Chelipeds identical, somewhat stouter than legs, with one or two small thornlike spines on distal lateral and inferior border of meropodite; carpopodite studded with a single spine at its distal inner margin; propodus serrulate; dorsal area of fingers palisaded with small black-apexed spines, some of which invade distal outer border of hand; when fingers are closed a hiatus is produced between them. Walking legs surpassing chelipeds, those on the right longer than those on left; propodite of legs more or less subcylindrical, dactylus of third left leg decidedly longer than propodite.

Previously reported from Mergui, Pulicat, Madras, Padaw or King Island, Singapore, and South India.

University of the Philippines zoölogical collections (0–345, 0–1073, 0–1241, and 0–1813) were obtained from Manila Bay; Taytay, Palawan Province; and Puerto Galera, Mindoro Province.

Genus PAGURUS Fabricius

Pagurus FABRICIUS, Suppl. Ent. Syst. 5 (1798) 411; DANA, U. S. Expl. Exp. Crust. pt. 1. (1852) 449; HENDERSON, Challenger Anomura (1888) 55.

Dardanus PAULSON, Rathbun, Proc. U. S. Nat. Mus. (1903) 33.

Pagurias J. E. BENEDICT, Bull. U. S. Fish Comm. XX 2 (1900) 141.

Carapace often but not always elongate, highly calcified from cervical groove to front; rostrum obsolete. Eyestalks stout, often constricted towards middle; basal scales far apart, broad at free ends; flagellum long and naked. External maxillipeds juxtaposed at base. Chelipeds usually unequal, rarely equal or subequal, left much larger. Finger apices corneous, somewhat excavated internally. Penultimate pair of legs subchelate. Pleon with four appendages on left side, occupying segments 2 to 5; biramous in male, triramous in female.

This genus is represented by nine species in the collection of the University of the Philippines.

Key to the species of Pagurus.

a[1]. Ocular stalk stout, shorter than antennular peduncle; cornea much dilated transversely; right cheliped much smaller than left.
  b[1]. Dactylus of left cheliped with prominent, serrate vertical crest on dorsal border .... *P. deformis* Milne-Edwards.
  b[2]. Dactylus of left cheliped without crest on dorsal border but with blunt tubercles only.
    c[1]. Entire external exposed area of left hand armed with uniform granules .... *P. dearmatus* Henderson.
    c[2]. Only superior outer area of left hand armed with two or three longitudinal series of granules or tubercles, rest entirely smooth. *P. asper* de Haan.
a[2]. Ocular stalk moderately long, equalling or slightly exceeding antennal peduncle.
  b[1]. Sagittal length of carapace longer than width of branchial region.
    c[1]. Left cheliped much more massive; outer area of left hand armed with sharp spines.
      d[1]. Exposed surface of last pair of crawling legs with numerous spines.
        e[1]. Chelipeds and legs very setose; hand of left cheliped not bent inwards.
          f[1]. Carapace and legs profusely maculated. *P. punctulatus* Olivier.
          f[2]. Carapace and legs not maculated........ *P. vulnerans* Thallwitz.
        e[2]. Chelipeds and legs moderately setose; hand of left cheliped bent inwards .... *P. wood-masoni* Alcock.
      d[2]. Exposed surface of left hand merely granulose, with few small spines on upper border.................................. *P. fabimanus* Dana.
    c[2]. Left cheliped distinctly larger but only slightly longer than right; with broad reddish crossbands on legs; chelipeds and legs setose. *P. euopsis* Dana.
  b[2]. Sagittal length of carapace only equal to width of branchial region; left cheliped slightly larger than right; very setose; dactylus and propodus of third left leg with transverse imbricating plates on outer surface.. *P. guttatus* Olivier.

1. PAGURUS DEFORMIS Milne-Edwards. Plate 1, fig. 10.

Pagurus deformis MILNE-EDWARDS, Ann. Sci. Nat. Zoöl. (2) 6 (1836) 272; ALCOCK, Cat. Ind. Decapod Crust. 2 Fasc. 1 (1905) 88, pl. 9, fig. 4.
Pagurus cavipes WHITE, P. Z. S. (1847) 122.
Pagurus cultratus WHITE, List Crust. Brit. Mus. (1848) 60.

Eyestalk stout, dilated distally, shorter than front margin of carapace; dactylus of left cheliped beset with a serrated vertical crest along its length; outer surface of left hand with two longitudinal grooves that gradually flatten out before reaching the base of dactylus.

Carapace somewhat flattened, naked except for line of hair tufts along anterolateral margins. Eyestalk stout, short, depressed, much dilated distally; decidedly shorter than anterior border of carapace and as long as or scarcely longer than antennal peduncle; corneal area transversely reniform; antennal acicle hirsute, serrated, distinctly longer than base of last segment of antennal peduncle. Legs and cheliped sparsely hairy; right cheliped much smaller than left; inferior inner border of merus of left cheliped "strongly alate but irregularly serrate;"[1] upper extensor surface of carpus with strong spines which are largest along upper and inner borders; outer surface of hand with two grooves that gradually disappear before reaching base of dactylus; inner upper border of hand with a line of sharp teeth interspersed with granules in between; lower margin distinct and crenate, lower outer surface devoid of any armature; upper margin of dactylus with a prominent longitudinal carina. Walking legs almost of the same length; propodite and dactylopodite of third left leg with upper margin of outer surface produced into an elegant, scabrous-edged overhanging crest; extensor surface of dactylopodite prominently grooved, propodite longitudinally and medially ridged.

Previously reported from Tahiti, Andamans, Balabac Straight, Ceylon, Mauritius, Seychelles, West Africa, Mergui, New Ireland, Papiete, South Seas, and Liu-Kiu Islands.

The University of the Philippines specimens were collected from Puerto Galera, Calapan, Mindoro Province, and Taytay, Palawan Province.

Newly collected specimens in alcohol: Carapace gray, shaded with reddish color; legs reddish orange, the color tending to form bands at middle of segment, especially on merus, carpus, and propodus; eyestalk with a brownish ring at base.

2. **PAGURUS DEARMATUS** Henderson. Plate 1, fig. 6.

> *Pagurus dearmatus* HENDERSON, Voy. H. M. S. Challenger 27 (1888) 58; ALCOCK, Cat. Ind. Decapod Crust. 2 Fasc. 1 (1905) 91, pl. 9, fig. 6.

Closely allied to *P. asper* but differing from it in entire outer surface of hand of left cheliped being uniformly studded with conical tubercles.

Unlike *P. asper,* entire outer area of left hand almost uniformly and closely tuberculose; dorsal surface of propodus of

[1] Alcock, loc. cit.

third left leg granulose, while its outer lower lateral side has minute depressions. As in *P. asper,* mobile finger of left pincher granulose and noncarinated above; outer upper margin of propodus of third left leg without carina.

So far reported from Admiralty Island, Ceylon, and Maldives. The University of the Philippines collections were obtained from Puerto Galera, Mindoro Province.

3. PAGURUS ASPER de Haan. Plate 1, fig. 14.

Pagurus asper DE HAAN, Fauna Japon. (1849) 208, pl. 49, fig. 4; ALCOCK, Cat. Ind. Decapod Crust. 2 Fasc. 1 (1905) 90, pl. 9, fig. 5.

Dardanus haani RATHBUN, Proc. U. S. Nat. Mus. (1903) 34.

No vertical serrated carina on dactylus of left cheliped. In its place two rows of conical tubercles.

This form differs from *P. deformis* in having the following characters: (*a*) Sharp serrated crest on dactylus of left cheliped reduced to merely two rows of rounded granules; (*b*) overhanging crest on upper margin of propodus of left leg obsolete or absent; (*c*) a strong longitudinal keel about lower border of outer surface of dactylus of third left leg.

Distribution of the species includes the Andamans, Ceylon, Japan, the Sandwich Islands, Australia, Batjan, and Port Jackson.

Local forms were collected from the shores of Mindoro.

4. PAGURUS PUNCTULATUS Olivier. Plate 1, fig. 3.

Pagurus punctulatus OLIVIER, Encycl. Method. 8 (1811) 639; ALCOCK, Cat. Ind. Decapod Crust. 2 Fasc. 1 (1905) 81, pl. 8, fig. 1.

Cancer megistos HERBST, Krabb. u. Krebse 3 (1804) 23, pl. 11, fig. 1.

Pagurus megistos OLIVIER, Encycl. Method. 8 (1811) 639.

Very shaggy, with numerous tufts of reddish hair; carapace, maxillipeds, abdominal terga, legs, cheliped, and tail fan copiously marked with white-centered and black-rimmed ocelli.

Carapace slightly compressed, its breadth across gill region two-thirds its sagittal length; anterolateral borders of carapace with clumps of hairs. Ocular stalk subcylindrical, strongly reniform, with eyes slightly dilated; peduncles considerably shorter than antennular but longer than antennal stalk. Acicle spinulose. Chelipeds and walking legs, especially dactylopodites, propodites, and carpopodites, provided with thick clusters of red setæ and dark-tipped spines; inner border of ischiopodite and

meropodite, along length of superior border of carpopodite and hand of left cheliped, strongly toothed. Left cheliped much larger than right; crawling legs, maxillipeds, carapace, tail fan, and pleonal terga profusely maculated with white-centered, dark-edged ocelli.

Known from Andamans, Nicobars, Mergui, Tahiti, Laccadives, Madagascar, Sumatra, Celebes, Australia, Liu-Kiu Islands, and Mozambique.

All the specimens in the University of the Philippines collection were collected from Puerto Galera and Calapan, Mindoro Province; and Taytay, Palawan Province.

5. **PAGURUS VULNERANS** Thallwitz. Plate 2, fig. 11.

Pagurus vulnerans THALLWITZ, Abh. u. Ber. K. Zoöl. Mus. No. 3 (1890) 33; ALCOCK, Cat. Ind. Decapod Crust. 2 Fasc. 1 (1905) 83.

Very setose, like *P. punctulatus,* but lacking white-centered dark-edged ocelli; carapace flattened; eyestalk longer than antennular peduncle.

In hairyness, proportion, form, and even in its spinosity, this species could easily be mistaken for *P. punctulatus* but for the following differences: Carapace of *P. vulnerans* compressed dorsoventrally; ocular peduncle as long as anterior border of carapace and a bit longer than antennular peduncle; no white-centered black-edged ocellation on carapace, maxillipeds, legs, and abdominal terga.

Previously known from Persian Gulf, Coromandel, and Bay of Bengal.

Our materials, 0–450 and 0–1429, were taken in Puerto Galera, Mindoro Province, and from Balabac Strait, Palawan Province, respectively.

6. **PAGURUS WOOD-MASONI** Alcock.

Pagurus wood-masoni ALCOCK, Cat. Ind. Decapod Crust. 2 Fasc. 1 (1905) 85, pl. 9, fig. 3.

Carapace, chelipeds, and legs scarcely penicillate; bristles yellow, red, or brownish red, always with white tops; dactylus of third left leg with a longitudinal canal on exposed surface; hand of left cheliped bent inwards.

Carapace dorsoventrally compressed, its length about one-eighth longer than its greatest breadth. Ocular stalk globular below, flattened above, slightly shorter than anterior border of carapace and as long as antennal peduncle; cornea of eyes

strongly reniform and moderately dilated. Acicle slender. Chelipeds and legs scarcely pilose; left cheliped decidedly but not greatly larger than right; left hand long, narrow, slightly bent inwards; borders of merus, especially inner, spiny; upper border and outer area of carpus spinose; hand and mobile finger studded with spines; superior margin of hand with two rows of strong spines, its lower edge serrated, appearing as a serrated crest. Ambulatory legs very long, exceeding tip of large cheliped; those on right longer than their left counterparts; carpus of legs distally beset with slender spines; many spinules along upper area of propodus and dactylus of each leg; dactylus of each leg with longitudinal furrow on external surface.

Known from Andamans, MacPherson Strait, and Maldives.

The University of the Philippines specimens were collected in Puerto Galera, Mindoro Province.

7. **PAGURUS FABIMANUS** Dana. Plate 1, fig. 2.

Pagurus fabimanus DANA, U. S. Expl. Exped. Crust. 1 (1852) 454, pl. 28, fig. *7a-c*; ALCOCK, Cat. Ind. Decapod Crust. 2 Fasc. 1 (1905) 84, pl. 8, fig. 2.

Eyestalk either as long as or slightly longer than anterior border of carapace; outer surface of big cheliped nonsetose, planted with tiny spiniform granules, which lose their prominence towards lower border; lower border sharply distinct from rest by becoming carinated; outer surface of propodus of third left leg separated from dorsal surface by a sharp dorsolateral edge.

Carapace slightly depressed, almost devoid of any bristles except for small tufts on anterolateral angles. Eyestalk somewhat broadened anteriorly, as long as or a bit longer than front margin of carapace. Acicle short. Only small cheliped and dactyli of legs with marked setæ; right cheliped much smaller than left; merus of left cheliped spinulose at distal lower outer margin; carpus, hand, and dactyli similarly beset with spinules on upper borders; lower border of hand delimited, either entire or crenulate. Last and penultimate segments of third left leg roughened, their outer surface flat and both upper and lower edges boldly relieved; dactylus of same leg with a canal along its entire length of the external surface.

Reported from Minnokoy, Mozambique, Funafuti, Tongatabu, Maldives and Laccadives, and Fiji.

This species (0–721) had been collected from Puerto Galera, Mindoro Province.

8. PAGURUS EUOPSIS Dana. Plate 1, fig. 7.

Pagurus euopsis DANA, U. S. Expl. Exped. Crust. 1 (1852) 452, pl. 27, figs. 6*a-c*; ALCOCK, Cat. Ind. Decapod Crust. 2 Fasc. 1 (1905) 86, pl. 9, fig. 2.

Pagurus depressus HELLER, S. B. K. Adad. Wien 46 (1861) 248; HILGENDORF, M. B. K. Akad. Berlin (1878) 814; DE MAN, Archiv. f. Nat. 53 (1) (1887) 431.

Eyestalk moderately long, as long as front margin of carapace and antennular stalk; cornea not dilated distally, specimen moderately hairy; walking legs with transverse wide reddish bands.

The specimens in our collection agree with *P. punctulatus* and *P. euopsis* in hairyness and spinosity of chelipeds and legs. They differ, however, from *P. punctulatus* in having much less numerous thornlike spines, especially on the legs. On the other hand, they agree with *P. euopsis* as described by Dana in the following manner: Carapace more depressed than in *P. punctulatus;* legs and chelipeds thickly provided with stiff, long, brownish bristles; disproportion between chelipeds much less prominent; propodus of third left leg flattened out on outer side, half as wide as long; gastric region of carapace with a large reddish orange patch which differs in color from the one described. Legs and chelipeds yellowish orange with white and red flecks, meri and carpi of both pairs of walking legs with broad dull brick-red crossbands that almost form complete rings.

Previously known from Tongatabu, Samoa, Seychelles, Mauritius, Andamans, Amboina, and Malay Archipelago.

Specimens in the University of the Philippines Zoölogical Collection (0–721 and 0–1536) were all gathered from along the coast of Mindoro.

9. PAGURUS GUTTATUS Olivier. Plate 1, fig. 13.

Pagurus guttatus OLIVIER, Encycl. Method. 8 (1811) 640; DE MAN, Abh. Senckenberg. Nat. Ges. 25 (1902) 738; ALCOCK, Cat. Ind. Decapod Crust. 2 Fasc. 1 (1905) 87, pl. 9, fig. 1.

Pagurus setifer HESS, Archiv. f. Nat. 31 (1865) 151; HASWELL, Cat. Austral. Crust. (1882).

Eupagurus setifer HASWELL, Cat. Austr. Crust. (1882) 154.

Carapace very much depressed; specimen very setose; a bald smooth patch on carpus of all legs and chelipeds is characteristic of the species.

Carapace greatly compressed with clumps of yellow bristles on anterolateral margins; greatest breadth equal to length of its sagittal line. Eyestalk slightly dilated; distinctly shorter than anterior border of carapace. Acicle hairy, bifid at tip, just reaching base of last segment of antennal peduncle. Chelipeds

and legs beset with long red bristles, forming a thick longitudinal brush on lower outer border of palm and along both upper and lower borders of last three joints of third left leg. Right cheliped slightly smaller than left; a bald smooth area on dorsal surface of carpi of chelipeds and legs easily distinguishes this form from all other species of *Pagurus;* ventral surface of dactylus and propodus of third left leg transversely scutellated by a series of overlapping plates.

This species has been so far reported from Mozambique, Sandwich Islands, Minnokoy, South Seas, Ibo, and Australia.

The lone specimen (0–1920) in the University of the Philippines collection was collected in Puerto Galera, Mindoro Province.

Genus ANICULUS Dana

Aniculus DANA, U. S. Expl. Exped. Crust. 1 (1852) 460.
Aniculus STEBBING, Hist. Crust. (1896) 160.
Aniculus ALCOCK, Cat. Ind. Decapod Crust. 2 Fasc. 1 (1905) 94.

Chelipeds and legs protected by more or less regular, crosswise, overlapping scutelike scales, the free edges of which are beautifully fringed with short cilia; chelipeds alike in size and shape, fingers short, somewhat horseshoe-shaped and deeply excavated internally; each biramous pleonal appendage in female covered by a large leaflike broad flap.

This genus appears to be intermediate between *Clibanarius* and *Pagurus.* Like the former it has a slender eyestalk and a distinct rostral projection. Like the latter it is very setose. Its body is similar to that of *Pagurus* in form and proportion of parts. It resembles both in having (*a*) external maxillipeds approximated at base; (*b*) antennal acicle short; (*c*) flagellum long and naked; (*d*) the fourth pair of legs subchelate. Unlike *Pagurus* it has a prominent rostrum. It differs from *Clibanarius* in having its chelipeds equal and similar.

ANICULUS ANICULUS (Herbst). Plate 2, fig. 2.

Cancer aniculus HERBST, Krabben u. Krebse 2 (1791) 37.
Pagurus aniculus FABRICIUS, Ent. Syst. 2 (1793).
Aniculus aniculus ALCOCK, Cat. Ind. Decapod Crust. 2 Fasc. 1 (1905) 94, pl. 7, fig. 6.
Pagurus ursus OLIVIER, Encycl. Method. 8 (1811) 640.
Aniculus typicus ORTMANN, Zool. Jahrb. Syst. 6 (1892) 289.

Very shaggy; chelipeds and legs broken into series of transverse imbricating plates; each plate fringed with stiff short cilia.

Carapace strongly calcified except around branchial region; width of branchial region about four-fifths sagittal length; ros-

trum broadly triangular, reaching well beyond base of ophthalmic scales. Antennal scale projecting beyond base of ultimate segment of antennal pedicel; flagellum long and naked. Ocular peduncle equal to length of second antennal pedicel, its scale with bifurcate apex; chelipeds alike in size and shape; ventral distal surface of merus with a socketlike depression for the reception of the carpus in retraction; scutella of chelipeds and some of legs oriented with spiniform tubercles on their free edges. All walking legs much longer than chelipeds, their dactyli nearly as long as propodites. Female pleonal appendages concealed under a broad leaflike bract or broad flap.

Professor Cowles remarked that individuals were found inhabiting burrows. Residents of Puerto Galera have informed the writer that this species is found not infrequently going around without its shell.

Previously reported from Auckland, Mozambique, Mauritius, Seychelles, Japan, Simoda, Wake, Paumotu, South Seas, India, Gulf of Manaar, and Rodriguez.

The specimens in the University of the Philippines collection (0–60, 0–170, and 0–377) were obtained from Puerto Galera, Mindoro Province.

Genus DIOGENES Dana

Diogenes DANA, U. S. Expl. Exped. Crust. 1 (1852) 438.
Diogenes HENDERSON, Voy. H. M. S. Challenger 27 (1888) 53.
Diogenes STEBBING, Hist. Crust. (1893) 160.
Diogenes ALCOCK, Cat. Ind. Decapod Crust. 2 Fasc. 1 (1905) 59.

Carapace elongated, with strongly calcified gastric region. No rostral projection, instead a rostriform process wedged in between ocular stalks. Ocular peduncle slender; ophthalmic scales broad, flanking rostriform process. Antennal acicle quite stout at base; antennal flagellum setose. Right cheliped smaller than left; finger apices pointed and calcareous. Walking legs with long dactylopodites, penultimate pair subcheliform and last chelate. Pleon well developed, membranous, twisted. Four abdominal appendages on left side, aside from telson. Those of male single; in female first three dichotomous.

There are two species in the collection of the University of the Philippines.

Key to the Philippine species of Diogenes.

*a*¹. Eyestalk in length equal to anterior border of carapace; hand of left cheliped long, narrow, twice as long as broad.......... *D. avarus* Heller.
*a*². Eyestalk only slightly surpassing anterior border of carapace; hand short, only slightly longer than wide............ *D. brevirostris* Stimpson.

1. DIOGENES AVARUS Heller.

Diogenes avarus HELLER, Novara Crustacea (1865) 83, pl. 7, fig. 2; DE MAN, Journ. Linn. Soc. London 22 (1888) 236; ALCOCK, Cat. Ind. Decapod Crust. 2 Fasc. 1 (1905) 68, pl. 6, fig. 6.

Rostriform process shorter than ophthalmic scale. Left cheliped larger than right, hand long and narrow with the immobile finger somewhat deflected outwards.

Carapace more or less nude dorsally though sparsely hirsute laterally; anterolateral angles serrulate. Mobile rostriform process merely a slender spinule, shorter than ophthalmic scale. Eyestalk stout and contracted; cornea large but not dilated; ophthalmic scale squamifom, triangular, denticulated on anterolateral margin. Antennal peduncle decidedly shorter than antennular; flagellum short, more setose below than above, each with three brownish orange rings; acicle merely a spine. Left cheliped much larger than right; carpus longer than merus; proximal area of palm produced into a short ridge that abruptly merges into general surface; immobile finger deflected outwardly. Right cheliped more pilose than left. Crawling legs smooth except for spinules and bristles on anterior dorsal margin of both carpus and propodus; dactyli pilose, longer than propodi. Legs, like flagella, provided with orange-colored rings on a whitish backgound. Rings strongly marked on propodites, becoming fainter on carpi and more so on meri.

Heretofore recorded from Nicobar, Mergui Islands, Singapore, Madras, Persian Gulf, and East Africa.

University of the Philippines collection specimens (0–1924) were gathered in Puerto Galera, Mindoro Province.

2. DIOGENES BREVIROSTRIS Stimpson.

Diogenes brevirostris STIMPSON, Smithsonian Misc. Coll. 49 (1907) 201, pl. 19, fig. 2.

Rostriform process shorter than ophthalmic scale; left cheliped very rough with calcareous granules; posterior portion of outer surface of hand produced into an oblique inferoposterior crest.

Carapace smooth at center but roughened by platelike ridges towards sides; anterior margin crenulate; rostriform process merely a thin and very short spinule reaching halfway beyond ophthalmic scale. Eyestalk short and stout, but equal to or slightly surpassing front border of carapace; cornea somewhat dilated; ophthalmic scale, whose antero-internal edge is serrulate, broadly triangular. Antennal peduncle longer than eyestalk, but decidedly shorter than antennular; acicle finely spinulate on

dorsal side, short; flagellum naked, shorter than carapace. Chelipeds naked, left much larger than right, general surface of both chelipeds rough with numerous subspiniform granules; superior border of merus crenulate, crenules becoming spinules distally; lower border also crenulate, distal outer margin unarmed except for few spinules on superior edge; carpus rough, upper edge serrated; a toothed lamina, from base of which several spines extend dorsad, on outer surface on median distal portion. Hand rough with pearly spiniform granules; external surface with an oblique inferoposterior crest in addition to a concave linear series of white granules occurring halfway between crest and superior margin; dactylus with longitudinal carina broken into a linear series of transverse laminar teeth. Right cheliped setose with carpus longitudinally grooved above, furrow reaching extensor surface of palm; superior margin of carpus beset with sharp spines. Crawling legs slender; upper border of carpus denticulated; propodus almost smooth above; dactylus setose, laterally compressed with a groove on outer surface.

Previously known from Simon's Bay (Cape of Good Hope), Faden, Monrovia, and Cape Verde Islands.

The lone specimen in the University of the Philippines collection has been obtained from Taytay, Palawan Province.

Genus CALCINUS Dana

Calcinus DANA, U. S. Expl. Exped. Crust. 1 (1852) 456.
Calcinus HENDERSON, Voy. H. M. S. Challenger 27 (1888) 61.
Calcinus ALCOCK, Cat. Ind. Decapod Crust. 2 Facs. 1 (1905) 51.

Carapace small, with distinct rostrum. Ocular stalk long and slender; basal scales small and close together. Antennal acicle short; flagellum naked. External maxillipeds close at base. Left cheliped much larger than right; finger apices of both chelipeds calcareous, concavely hoofed. Penultimate pair of legs cheliform, last chelate. Chelipeds, legs, and gastric region porcellanous. Ambulatory legs with short dactylopodites. Pleon soft, membranous, twisted; dorsal terga far apart; no paired appendages except telson. Four pleonal appendages biramous in both sexes.

There are four species of this genus in the University of the Philippines Zoölogical Collection.

Key to the Philippine species of Calcinus.

a [1]. Ocular stalk equal to front border of carapace; superior border of right hand entire; propodus and dactylus of last crawling legs naked on caudal border .... *C. herbstii* de Man.

a [2]. Ocular stalk greatly exceeding length of front border of carapace; superior margin of right hand serrated; dactylus and propodite of legs more or less hirsute.

b [1]. Legs with rings of variable colors; fingers beset with pearly granules. *C. elegans* (Milne-Edwards).

b [2]. Legs without rings or crossbands.

c [1]. Inferior margin of left hand entire, not produced into a toothed carina; proximal ends of dactyli of second and third pair of legs either violet or purple................................ *C. terræ-reginæ* Haswell.

c [2]. Inferior margin of left hand produced into a toothed carina. *C. latens* (Randall).

1. **CALCINUS HERBSTII de Man. Plate 2, fig. 5.**

Calcinus herbstii DE MAN, Archiv. f. Naturg. 53 (1887) 437; ALCOCK, Cat. Ind. Decapod Crust. 2 Fasc. 1 (1905) 53, pl. 5, fig. 4.

Pagurus tibicen MILNE-EDWARDS, Ann. Sci. Nat. Zoöl. (2) 6 (1836) 278.

Pagurus lævimanus RANDALL, Journ. Acad. Phila. 7 (1839) 135.

Ocular stalk as long as front border of carapace, but exceeding length of antennular peduncle; chelipeds entirely smooth, left much larger. Carpus of left cheliped provided with oblique groove on outer surface.

Rostrum small but distinct. Ocular peduncle slightly curved laterally, almost as long as anterior border of carapace, longer than antennular peduncle; basal scale small, triangular, acute. Antennal acicle short, spinose on dorsal border; flagellum nonsetose, exceeding length of carapace. Chelipeds completely smooth, left vastly the larger; exterior surface of carpus engraved with an inwardly directed canal which fades out before reaching superior border; both fixed and mobile fingers when closed resting against each other throughout entire length; both beset with few hair tufts on concave inner borders. Crawling legs much shorter than left cheliped; legs smooth, with a spinule at distal superior margin of carpopodite; dactylopodite much shorter than propodite and ornamented with few tufts of bristles on ventral edges; longitudinal dark-brown stripe marks exposed surface of brick-red ring around and about tips and a stipling of same color at their proximal ends on exposed surface; tarsi black.

Known from Nicobars, Tahiti, Coco Island, Mauritius, Palk Strait, Mozambique, Zanzibar, Natal, Seychelles, Ceylon, Amboina, Balabac Strait, Sandwich Islands, Wake, Samoa, Paumotu, and Bonin Island.

University of the Philippines materials (0–345, 0–327) were obtained from Pasay, Rizal Province, and Puerto Galera, Mindoro Province.

2. CALCINUS ELEGANS (Milne-Edwards). Plate 2, fig. 10.

Pagurus elegans MILNE-EDWARDS, Hist. Nat. Crust. 2 (1837) 229.
Calcinus elegans DANA, U. S. Expl. Exped. Crust. 1 (1852) 458, pl. 27, fig. 10; ALCOCK, Cat. Ind. Decapod Crust. 2 Fasc. 1 (1905) 55, pl. 5, fig. 2.
Pagurus pictus OWEN, Zoöl. H. M. S. Blossom Crust. (1839) 38, pl. 25, fig. 2.
Pagurus decorus RANDALL, Journ. Acad. Phila. (1839) 134.

Acicle studded with small spines, quite long, even going well beyond base of last segment of antennal peduncle; fingers and adjacent regions of both chelipeds beautifully studded with white pearly granules.

Ocular peduncle slender, much longer than front border of carapace, exceeding antennular pedicel by a corneal length. Acicle spinose, exceeding base of last segment of antennal peduncle. Right cheliped smaller than left; superior border of hand of right cheliped broken into four or five strong teeth. Left cheliped unarmed except for a few spinules on distal margin of meropodite; fingers tongs-shaped. In both chelipeds finger and environs dotted with numerous closely set pearly granules. Walking legs setose on posterior borders; dactylus of second pair of legs thickly planted with closely set hair tufts appearing like a brush.

Reported previously from Tahiti, South Seas, Natal, Mauritius, Seychelles Islands, Liu-Kiu Islands, Sandwich Islands, Wake, Paumotu, New Ireland, and Laccadive Islands.

University of the Philippines Zoölogical Collection 0–327 and 0–333, collected in Puerto Galera, Mindoro Province.

3. CALCIMUS TERRÆ-REGINÆ Haswell.

Calcinus terræ-reginæ HASWELL, Proc. Linn. Soc. N. S. Wales 6 (1881) 760; DE MAN, Archiv. f. Naturg. 53 (1887) 439; ALCOCK, Cat. Ind. Decapod Crust. 2 Fasc. 1 (1905) 57, pl. 5, fig. 7.

Acicle quite long, overlapping base of last segment of peduncle; chelipeds unequal, the left slightly the larger; groove on carpus of left cheliped more or less obsolete; hand of right

cheliped reproduced into a sort of vertical crest; dactylus of legs marked with color bandings.

Ocular peduncle slender. Antennal acicle exceeding base of ultimate segment of pedicel; flagellum long. Oblique canal of carpus of left cheliped almost obsolete, its place marked by a white-tipped tubercle; fingers meeting only at tips. Right cheliped with calcareous spinules at superior distal margin of carpus; superior edge of palm produced into a vertical crest broken into four or five teeth; dactylus on same margin broken also into more or less similar serrulation. Walking legs longer than left cheliped; dactyli a bit longer than propodites, white but with purple rings around bases; bristles scarce, thin tufts on lower distal border of carpopodite and lower border of dactylopodite of third pair of legs.

The specimens in the collection of the Department of Zoölogy, University of the Philippines, have their eyestalk asymmetrical, the right the longer. The discrepancy in length varies from one to two corneal lengths.

This species has been reported from Minnokoy, Gulf of Bengal, Malay Archipelago, Mergui Islands, and the West Coast of Australia.

4. CALCINUS LATENS (Randall).

Pagurus latens RANDALL, Journ. Acad. Phila. (1839) 135.
Calcinus latens ALCOCK, Cat. Ind. Decapod Crust. 2 Fasc. 1 (1905) 58, pl. 5, fig. 5.
Calcinus intermedius DE MAN, Notes Leyden Mus. 3 (1881) 102.

Distal superior margin of carpus of cheliped serrated; extensor surface of carpus made rugged by presence of scattered denticles, aside from white-tipped tubercle marking off manifestation of obsolescent oblique groove; superior border of hand and dactylopodite of right cheliped armed with series of anteriorly directed spinules; lower border of hand distinctly produced into a carina broken into a series of sawlike teeth.

Observations on this species are based upon only one specimen. It seems that this species is allied to *C. terræ-reginæ*. Alcock expresses the opinion that this may be the type of the species, and that *C. terræ-reginæ* is merely a variety. However, he keeps the latter as a distinct species. The present writer is of the opinion that since there exist differences wide enough to distinguish one type from the other, the retention of *C. latens* as a separate species from *C. terræ-reginæ* is justified.

This species was previously reported from Sydney, Tahiti, Liu-Kiu Islands, Amani Oshima, Ibo, Mozambique, Sandwich Islands, Fiji Islands, Mauritius, Wake, and Tongatabu.

This lone specimen (0–1923) in the University of the Philippines Zoölogical Collection was obtained from Puerto Galera, Mindoro Province.

Genus EUPAGURUS Brandt

Eupagurus BRANDT, Middendorf's Reise in Sibirien Zool. (1) 2 (1851) 150.
Eupagurus ORTMANN, Jahrb. Syst. Zool. 6 (1891–92) 297.
Eupagurus ALCOCK, Cat. Ind. Decapod Crust. 2 Fasc. 1 (1905) 122.
Bernhardus DANA, U. S. Expl. Exped. Crust. 1 (1852) 440.

Carapace strongly calcified about gastric region; rostrum usually distinct. Ocular peduncle either short and stout or long and slender; ophthalmic scales widely separate. Antennal acicle long and slender; flagellum long, either naked or more or less pilose. Third maxillipeds widely separate at base. Chelipeds unequal, the right the larger; fingers with calcareous apices. Penultimate pair of legs subchelate. Abdomen soft, membranous, twisted; four biramous appendages in both sexes.

Under this genus there are only two species so far found in the Philippines; one was collected by the Challenger in 1888, and the other is *Eupagurus janitor* Alcock.

EUPAGURUS JANITOR Alcock. Plate 2, fig. 1.

Eupagurus janitor ALCOCK, Cat. Ind. Decapod Crust. 2 Fasc. 1 (1905) 132, pl. 11, fig. 6.

Eyestalk very short, stout; ophthalmic scale grooved from dorsal area; right cheliped much larger than left; hand broadly ovate with flattened dorsal side. Carapace broadened posteriorly; gastric region polished, tufts of setæ on dorsolateral borders of gastric and lateral sides of branchial regions; rostrum triangular and acuminate, projecting far between the ophthalmic scales. Ocular stalk subcylindrical, much shorter than front border of carapace, stout; eyes dark, bulging laterally. Antennular peduncle shorter than antennal; acicle hirsute, long, narrow, curved, deflected sidewards; flagellum long and naked. Both chelipeds shaggy, with woolly hair. Left cheliped much smaller than right, the former slender; carpus planted with two longitudinal rows of clawlike spines; fingers rounded at tips and greatly excavated internally. Right cheliped clumsy-looking, with hand flattened dorsally, simulating an operculum; hand permanently flexed; merus unarmed; carpus hirsute, bearing a

longitudinal row of clawlike spines on dorsal area; two or three similar spines present on distal superior border; hand much wider than long, even wider than carpus; fixed finger much broader than dactylus; finger apices calcareous. Legs setose, slightly longer than right cheliped. Dactyli of crawling legs ending in black claws, their ventral sides bearing a linear series of sharp amberlike spines. Merus, carpus, and propodus of walking legs with wide crossbands of chocolate-brown; spots of similar color found elsewhere on carapace, legs, and chelipeds.

Previously reported from Halulu Male Atoll and Maldive Islands.

The University of the Philippines materials (0–1517, 0–1521, 0–1922) were collected in Baco Island, and Calapan and Puerto Galera, Mindoro Province.

Family CŒNOBITIDÆ Dana

Cœnobitidæ DANA, U. S. Expl. Exped. Crust. 1 (1852) 432.
Cœnobitidæ STEBBING, Hist. Crust. (1893) 155.
Cœnobitidæ ALCOCK, Cat. Ind. Decapod Crust. 2 Fasc. 1 (1905) 138.

Carapace either elongate or ovate posteriorly. Rostrum prominent or totally absent. Ophthalmic scale small, vertically laminate. Antennular peduncle very long, the first segment deflexed, the other two narrow and subcylindrical. Flagella biramous, truncate. External maxillipeds near each other at base. Chelipeds massive, left decidedly larger than right. Crawling legs very long; last and penultimate pairs reduced, penultimate either cheliform or subcheliform, last cheliform. Abdomen soft, membranous, spiral or simply bent under the cephalothorax and strongly calcified. Male without well-developed and recognizable abdominal appendages except telson. Female with a prominent dichotomous appendage on left side.

Key to the two known genera of the Cœnobitidæ.

a^1. Rostrum degenerate or obsolete; abdomen well developed, soft, twisted, not protected by well-calcified terga........................ *Cœnobita* Latreille.
a^2. Rostrum very prominent; abdomen simply bent under distal portion of carapace, not twisted but protected by strongly calcified terga. *Birgus* Leach.

Genus CŒNOBITA Latreille

Cœnobita LATREILLE, Fam. Nat. du Anim. (1812) 276; MILNE-EDWARDS, Hist. Nat. Crust. 2 (1837) 238; DE HAAN, Faun. Japon. Crust. (1849) 203; STEBBING, Hist. Crust. (1893) 315.

Carapace more or less contracted, solid, strongly tapering anteriorly, the greater portion angular with dorsal surface. Ros-

trum rudimentary. Ocular stalk short, strongly compressed it produces a sharp vertical edge although it appears laminar dorsally; cornea external and terminal. Antennular peduncles very long, stout, cylindrical at base, strongly compressed at their last two distal segments; flagellum dichotomous, upper ramus wider and much longer than lower one. Antennal peduncle pressed laterally. External maxilliped close together at base. Chelipeds unequal, the left vastly the larger; hands short, gradually compressed towards fingers; finger tips calcareous or corneous. Walking legs stout, longer than chelipeds; fourth pair almost rudimentary; fifth cheliform. Abdomen soft, membranous, bent on itself. Three pleonal appendages present on left side, biramous in female and rudimentary in male.

There are only four species and one variety so far known in the Philippines.

Key to the Philippine species of Cœnobita.

*a*¹. Inner surface of hand of both chelipeds with a triangular brush of hairs.
- *b*¹. Upper outer area of left hand with an oblique series of vertical laminar teeth.
  - *c*¹. External area of propodus of third left leg plane, sharply delimited from anterior surface by an obtuse crest; left vas deferens of male not prominently produced ventrally. *C. rugosa* Milne-Edwards.
  - *c*². External surface of propodus of third left leg ventrally concave, not delimited from the anterior surface by a crest; right vas deferens protruding prominently to form a long tube. *C. perlata* Milne-Edwards.
- *b*². Vertical series of laminar teeth absent, vas deferens retracted inside coxæ of fifth pair of legs.......................... *C. cavipes* Stimpson.

*a*². Inner surface of hand of right cheliped only with a triangular brush of hairs.
- *b*¹. Ventral margin of left hand without a groove. *C. clypeata* (Herbst).
- *b*². Ventral margin of left hand with a groove. *C. clypeata puerto-galeræ* var. nov.

1. **CŒNOBITA RUGOSA** Milne-Edwards. Plate 2, fig. 7.

Cœnobita rugosa MILNE-EDWARDS, Hist. Nat. Crust. 2 (1837) 241; ALCOCK, Cat. Ind. Decapod Crust. 2 Fasc. 1 (1905) 143, pl. 24, figs. 3–3*a*.

Cœnobita compressa var. *rugosa* BOUVIER, Bull. Sci. Philom. (8) 3 (1890–1891) 21.

Cœnobita clypeata OWEN, Zoöl. H. M. S. Blossom Crust. (1839) 85.

Cœnobita compressus DE MAN, Abh. Senckenb. Nat. Ges. 25 (1902) 742, pl. 21, fig. 45.

Hands of both chelipeds with a brush of long hairs on inner surface. An oblique series of vertical teeth conspicuous on outer upper area of left palm. Anterior surface of last two segments of third left leg separated from external border by a crest. Acicle free.

Carapace very slightly convex; gastric region almost flat, with four blackish brown spots, two posterior spots in a lyrelike arrangement. Ocular peduncle laterally compressed, almost twice as long as high; scales triangular, sharply pointed. Chelipeds and legs finely granulose, slightly rugulose; a series of oblique and parallel laminar crests on superior border of outer area of hand of left cheliped; propodus and dactylus of third left leg flat on outer surface. Dactyli short, triangular; external and superior border of last two segments of third left leg separated from anterior surface by an obtuse crest. Coxæ of fifth pair of legs in both sexes quite salient, more so in male where right is more salient than left.

Reported from Nicobars, Sydney, Andamans, Ceylon, Laccadive Islands, Madras, Samoa, Mergui Islands, Wake, Sulu Sea, Japan, Mauritius, Mozambique, Bonin, and New Hebrides.

Specimens in the University of the Philippines collection were obtained from Puerto Galera, Mindoro Province; Kolambugan, Lanao Province; and Taytay, Palawan Province.

3. CŒNOBITA PERLATA Milne-Edwards. Plate 2, fig. 3.

Cœnobita perlata MILNE-EDWARDS, Hist. Nat. Crust. 2 (1837) 242.
Cœnobita purpurea STIMPSON, Proc. Acad. Sci. Phila. (1852) 245.
Cœnobita perlatus ORTMANN, Jahrb. Syst. Zool. 6 (1892) 319, pl. 12, fig. 25; ALCOCK, Cat. Ind. Decapod Crust. 2 Fasc. 1 (1905) 145, pl. 14, figs. 2–2*a*.

Vertical series of teeth on outer surface of hand of left cheliped gradually passing anteriorly into an ordinary corneous-tipped conical granule; coxa of right fifth leg of male protruding to form a long vas deferens.

Carapace slightly convex, strongly tumid behind front; gastric region copiously granulated; cardiac and branchial regions punctate. Eyestalks compressed; ophthalmic scale triangular, sharply pointed. Acicle with serrulate or crenulate border, small, merged with second joint of antennal peduncle. External and anterior surface of legs and chelipeds beset with corneous-tipped conical tubercles tending to become spinules towards extremities. A stridulating organ composed of "an oblique series of oblique, laminar tubercles" adorning superior border of ex-

ternal surface of hand of left cheliped; tubercles gradually pass anteriorly into general surface as ordinary conical tubercles. A triangular brush of long hairs present on upper inner borders of both hands. Ambulatory legs moderately setose, more so on the right side; dactyli of right crawling legs slightly flattened; those of left triangular, propodus laterally compressed but not flat, with no prominent crest to separate it from its dorsal plane; dactylus of left legs internally concave, each provided with a serrated longitudinal ridge. Coxa of right last leg of male projecting ventrally into a long tube.

Thus far reported from Nicobars, New Hebrides, Andamans, Laccadive Islands, Japan, Bonin, Fiji Islands, Samoa, and South Seas.

There are nine specimens (0–1903) in the University of the Philippines Zoölogical Collection.

3. CŒNOBITA CAVIPES Stimpson. Plate 1, fig. 12.

Cœnobita cavipes STIMPSON, Proc. Acad. Nat. Sci. Phila. (1852) 254; ALCOCK, Cat. Ind. Decapod Crust. 2 Fasc. 1 (1905) 146, pl. 14, fig. 1.

Cœnobita violascens HELLER, Verh. Zool. Bot. Ges. Wien 12 (1862) 524.

Cœnobita compressa MIERS, Ann. & Mag. Nat. Hist. (5) 5 (1880) 371; ORTMANN, Jahrb. Syst. Zool. 6 (1892) 316.

Cœnobita compressus NOBILI, Ann. Mus. Genov. (2) 22 (1900) 495, Fauna and Geog. Mald. and Lacc. Arch. (1) 1 (1901) 97.

Hand of each cheliped with a brush of yellowish hairs about the superior margin on inner surface; acicle merged with second joint of antennal peduncle.

Gastric region stippled with minute depressions; its lateral borders rough, provided with bristles. Eyestalk short, laterally compressed. Ophthalmic scale small, triangular, with very acute apex. Antennal acicle fused with second joint of antennal pedicel. Merus of cheliped traversed by cross-rugulose ridges; carpi studded with small tubercles; similar tubercles arming outer surface of right palm, with one to three bristles arising from base of latter; dactylus of cheliped beset with corneous-tipped spinules; on inner surface and about superior border of both hands a triangular brush of long hairs. Walking legs as long as chelipeds; dorsal surface of last three segments comparatively smooth, finely punctate; right dactylopodites more or less cylindrical, triangular, with flat outer surface.

Reported from Mombas, Java, Borneo, Penang, Mozambique, Nicobars, Mergui Islands, Batjan, Zanzibar, Japan, Kendoa, and Andaman Islands.

The University of the Philippines specimens were collected from the coast of Mindoro; Kolambugan, Lanao Province; Batag, Samar Province; and Taytay, Palawan Province.

4. **CŒNOBITA CLYPEATA (Herbst). Plate 2, fig. 12.**

Cancer clypeata HERBST, Krabben u. Krebse 2 (1796) 22, pl. 23, fig. 2.

Cœnobita clypeata LATREILLE, Fam. Nat. du Anim. (1828) 277; ALCOCK, Cat. Ind. Decapod Crust. 2 Fasc. 1 (1905) 142, pl. 15, figs. 1–1*a*; HELLER, Novara Crust. (1865) 82; ORTMANN, Zool. Jahrb. Syst. 6 (1892) 316; HENDERSON, Challenger, Anomura (1888) 51.

Hand of right cheliped only provided with a triangular brush of long hairs; acicle spear-shaped, not fused with second segment of antennal peduncle.

Carapace well calcified, convex dorsally and copiously pitted; lateral borders of branchial region concave on its anterior half. Ocular peduncle longer than anterior border of carapace, distinctly angular ventrally but appearing subcylindrical dorsally; ophthalmic scale bladelike, with rounded crenulate end. Acicula minute, laterally compressed, free from second joint of peduncle. Meri of chelipeds beset with a series of transverse broken rough ridges; carpi provided with corneous tubercles; hands similarly studded; a brush of long stiff hairs on inner margin of right palm only. Crawling legs pitted; last three segments studded with spinulelike tubercles with black tips, especially on dorsal surface. Coxæ of fifth pair of legs of male modified ventrally to form a protruding vas deferens.

Previously reported from Nicobars, Tahiti, Laccadive Islands, South Seas, West Africa, Te River, and Burma.

The University of the Philippines specimens (0–31, 0–442, 0–1850, and 0–1905) of this species were collected on the coast of Mindoro.

5. **CŒNOBITA CLYPEATA var. PUERTO-GALERÆ var. nov. Plate 2, figs. 8 and 9.**

Our specimens on close examination show a definite departure from *C. clypeata* as described by Latreille or Alcock. Though the difference does not seem to warrant creation of a new species, the writer believes that, at least, there is justification for the establishment of a new variety under this species. The proposed

variety differs from the type in the following particulars: (*a*) Outer surface of hand of left cheliped very finely granular, almost smooth, except for some pustular tubercles on first third of upper area; (*b*) inferior border of left hand not entire but deeply grooved by an inwardly directed cut near proximal end.

The type (0–1915) of var. *puerto-galeræ* is kept in the Department of Zoölogy, University of the Philippines.

The Philippine materials were collected on the coast of Mindoro.

Genus BIRGUS Leach

Birgus LEACH, Trans. Linn. Soc. 11 (1815) 337.
Birgus MILNE-EDWARDS, Hist. Nat. Crust. 2 (1837) 244.
Birgus HENDERSON, Voy. H. M. S. Challenger 27 (1888) 49.
Birgus ALCOCK, Cat. Ind. Decapod Crust. 2 Fasc. 1 (1905) 148.

Carapace contracted anteriorly, branchial region broad-ovate. Rostrum prominently projecting forward. Ocular peduncle subcylindrical; ophthalmic scale close together, partly covered by downward deflexion of rostrum. External maxillipeds close together at base. Chelipeds of both legs large, the left notably larger. Crawling legs all stout; penultimate and last pairs of legs cheliform, especially the former, which look like regular chelipeds. Abdomen very broad, short, simply bent under cephalothorax, neither twisted nor spiral. Tergal plates of second, third, fourth, and fifth somites strongly calcified, broad, overlapping posteriorly with pleural plates flanking them on either side; tergal plate of sixth somite and tail fan much reduced; ventral surface of abdomen membranous; abdominal appendages attached on left side on segments two to four, those of male rudimentary; those of female hirsute and biramous.

BIRGUS LATRO (Herbst). Plate 2, fig. 13.

Cancer latro HERBST, Krabb. u. Krebse 2 (1791) 34, pl. 24.
Cancer crumenatus RUMPH, Amboinsch. Rariteitk. (1705) 7, pl. 4.
Cancer crumenatus orientalis SEBA, Thesaur. 3 (1761) pl. 21, figs. 1, 2.
Pagurus latro LATREILLE, Hist. Nat. Crust. 6 (1803) 164.
Pagurus laticauda (Latreille) CUVIER, R. A. 18 (1849) pl. 43, fig. 1.
Birgus latro LEACH, Trans. Linn. Soc. 11 (1815) 337; DE HAAN, Faun. Japon. Crust. (1849) 212; DANA, U. S. Expl. Exped. Crust. 1 (1852) 474, pl. 30, fig. 5; ALCOCK, Cat. Ind. Decapod Crust. 2 Fasc. 1 (1905) 15, pl. 16.
Birgus laticauda DESMAREST, Dict. Sci. Nat. 28 (1823) 290.

Carapace ovate and transversely rugulose; rostrum very prominent, partly concealing ophthalmic scales; coxæ of fifth pair of legs not saliently produced in male; much less so in female.

Carapace transversely cut into furrows, the cut tending to become semilunar in the gastric region. Rostrum prominent and acute. Ocular stalk subcylindrical; eyes terminal, somewhat ventral; ophthalmic scales laminar, close together, partially hidden off by ventral deflexion of rostrum. Legs and chelipeds also transversely cut into rugæ which have no tendency to become semilunar; rugose ridges of propodites fringed with short hairs and black corneous tubercles; dactyli of second, third, and fourth pairs of legs broadly spiniform.

Previously known from Ternate, Java, Flinders Island, Liu-Kiu Islands, Paumotu, Amboina, Comoro Islands, Mauritius, and Andamans.

Five Philippine specimens (0–190, 0–706) were collected on Cabro Island, Mindanao Province, and Puerto Galera, Mindoro Province.

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ILLUSTRATIONS

[Unless otherwise stated, the figures are of natural size.]

PLATE 1

FIG. 1. *Clibanarius striolatus.*
2. *Pagurus fabimanus.*
3. *Pagurus punctulatus.*
4. *Clibanarius clibanarius.*
5. *Clibanarius padavensis.*
6. *Pagurus dearmatus.*
7. *Pagurus euopis;* × 0.5.
8. *Clibanarius cruentatus.*
9. *Clibanarius eurysternus.*
10. *Pagurus deformis.*
11. *Clibanarius corallinus.*
12. *Cœnobita cavipes;* × 0.5.
13. *Pagurus guttatus.*
14. *Pagurus asper.*

PLATE 2

FIG. 1. *Eupagurus janitor.*
2. *Aniculus aniculus;* × 0.5.
3. *Cœnobita perlata.*
4. *Clibanarius infraspinatus.*
5. *Calcinus herbstii.*
6. *Clibanarius sclopetarius.*
7. *Cœnobita rugosa.*
8. *Cœnobita clypeata* var. *puerto-galeræ.*
9. Left cheliped of *Cœnobita clypeata* var. *puerto-galeræ.*
10. *Calcinus elegans.*
11. *Pagurus vulnerans.*
12. *Cœnobita clypeata;* × 0.5.
13. *Birgus latro;* × 0.5.

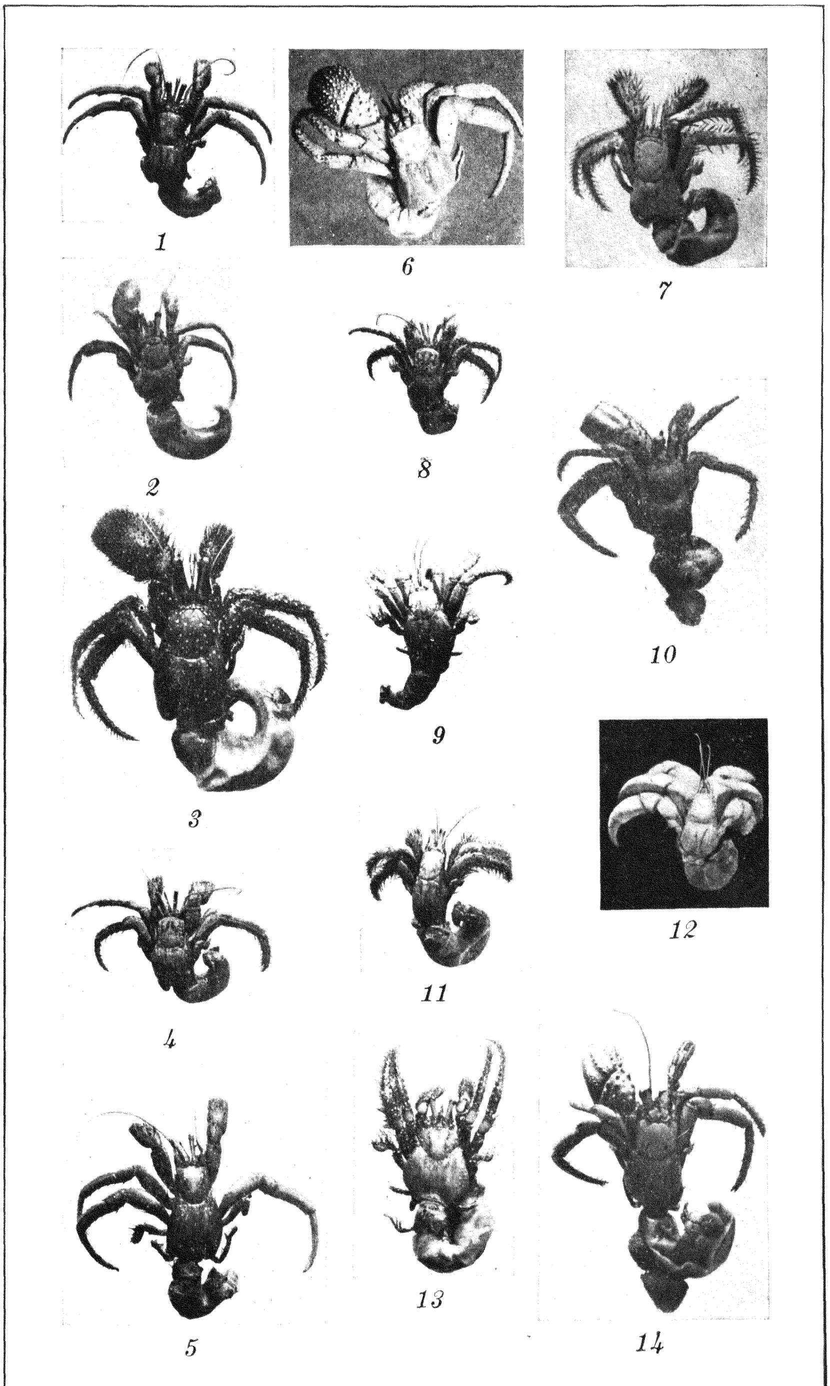

PLATE 1.

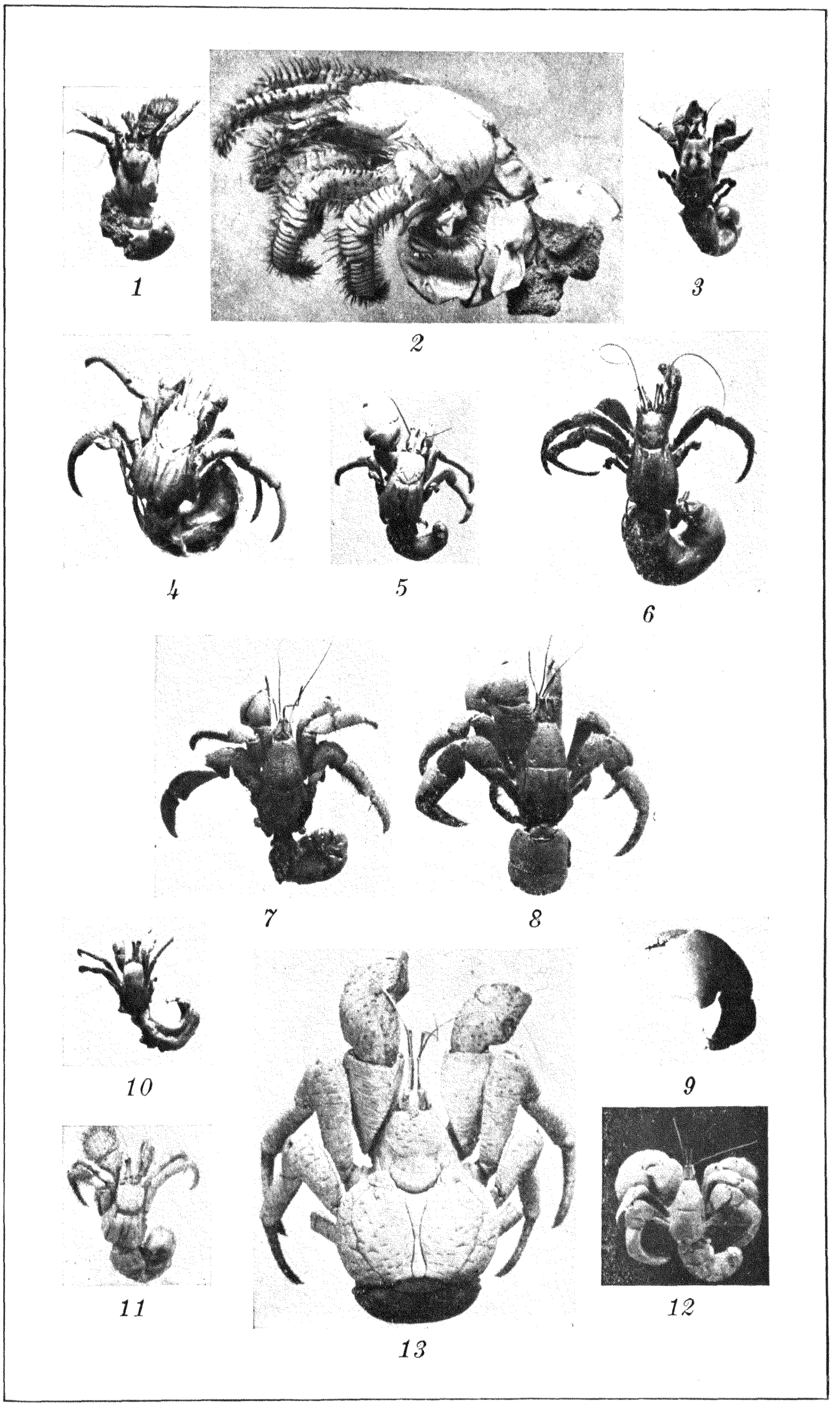

PLATE 2.

NEW OR LITTLE-KNOWN TIPULIDÆ FROM EASTERN ASIA (DIPTERA), XXXVII [1]

By CHARLES P. ALEXANDER
Of Amherst, Massachusetts

THREE PLATES

The crane flies herewith considered have been derived from several sources, the chief ones being as follows: Extensive collections from Java and eastern Borneo, collected by Mrs. M. E. Walsh; material from the Khasi Hills, Assam, taken by Mr. S. Sircar; specimens from various provinces in China, taken by Messrs. Franck, Gressitt, and Kellogg; material from New Guinea and the Philippines, preserved in the Museum of Comparative Zoölogy, Cambridge, Massachusetts. Except where indicated to the contrary, the types are preserved in my own collection of these flies. As often in the past, my sincere thanks are extended to the various collectors of this abundant and valuable series of Tipulidæ. A single species of Tanyderidæ, considered as being the most generalized family of crane flies, is described at this time.

TANYDERIDÆ

EUTANYDERUS OREONYMPHA sp. nov. Plate 1, fig. 1.

General coloration gray, variegated with black; antennæ 17-segmented, black throughout; halteres yellow, knob dark brown; femora black, bases broadly yellow; tibiæ black with a broad yellow central ring; wings whitish subhyaline, with four oblique brown crossbands, the third very oblique, extending completely across wing from midlength of cell Sc_1, involving outer end of cell 1st M_2; abdominal tergites black, light gray sublaterally.

Male.—Length, about 15 millimeters; wing, 13; antennæ, about 3.

Rostrum black, dusted with gray, nearly as long as remainder of head; palpi black. Antennæ 17-segmented, black throughout; flagellar segments suboval to subcylindrical, the second shorter than the first, the succeeding segments very gradually decreasing

[1] Contribution from the Department of Entomology, Massachusetts State College.

in size outwardly; terminal segment a little larger than penultimate. Head gray, with black verticils.

Pronotum and cervical sclerites gray, narrowly blackened medially. Mesonotal præscutum light gray, with three very conspicuous black stripes, median stripe very narrowly divided by a pale capillary vitta; setæ of interspaces yellow, conspicuous; scutum gray, each lobe with two blackish areas; scutellum and short mediotergite gray. Pleura and pleurotergite gray. Halteres yellow, knob dark brown. Legs with coxæ gray pruinose; trochanters black, pruinose; femora black, bases broadly yellow, including slightly less than proximal half; tibiæ black, with a conspicuous yellow central ring, subequal in extent to the dark apex and about twice as wide as blackened base; tarsi black. Wings (Plate 1, fig. 1) with ground color whitish subhyaline, conspicuously patterned with brown, including all of cell C excepting a small pale spot near outer end and four solidly darkened, unmargined, darker brown oblique fasciæ, distributed as follows: Basal fascia including anterior prearcular field and a postarcular area to the general level of origin of Rs, sending a distal extension in cell R to beyond midlength of Rs and a narrow seam along vein Cu to second dark fascia; a conspicuous ground area in cell R before origin of Rs, extending into cell M behind; second dark fascia narrow, completely traversing wing at cord, in cells R_4 and R_5 sending a distal extension almost to third band; third band complete, oblique, narrow, almost parallel-sided, extending from costa at near midlength of cell Sc_1, involving outer end of cell 1st M_2; distal band occupying narrow wing apex in cells R_1 to R_4 and extreme outer ends of cells Sc_1 and R_5; additional isolated dark spots include a circular area at fork of Sc and marginal spots at M_1, M_3, and Cu_1; veins yellowish brown, darker in patterned areas. In one wing of type a circular dark spot at fork of R_{2+3}. Venation: Cell R_2 about one and one-third as long as its petiole.

Abdominal tergites light gray laterally, segments broadly and continuously blackened medially, caudal margins of segments more narrowly blackened, on outer segments continued basad along lateral margin to form conspicuous outer lateral triangles; hypopygium black.

Habitat.—New South Wales.

Holotype, male, Mount Kosciusko, altitude 5,000 feet, December 11, 1931 (*A. L. Tonnoir*). Presented by collector to Dr. P. J. Darlington, of the Harvard Australian Expedition; type in the Museum of Comparative Zoölogy, Cambridge, Mass.

Eutanyderus oreonympha is very different from the only other known species of the genus, *E. wilsoni* Alexander, of Victoria, in the larger size, in the increased number of antennal segments, and in the very different pattern of the legs and wings. There are now six species of Tanyderidæ known from Australia and Tasmania, separable by the following key.

Key to the Australian species of Tanyderidæ.

1. A short element R_{4+5} present; antennal flagellum entirely or chiefly black. 2.
   A short element R_{2+3+4} present; antennal flagellum yellow (*Radinoderus* Handkirsch) .... 4.
2. Free tip of Sc_2 preserved; a supernumerary crossvein in cell R_1. (*Nothoderus* Alexander, Tasmania). *Nothoderus australiensis* (Alexander).
   Free tip of Sc_2 atrophied; no supernumerary crossveins in any of the cells. (*Eutanyderus* Alexander) .... 3.
3. Antennæ 15-segmented; tibiæ uniformly brown; cell R_2 shorter than its petiole. (Victoria) .... *Eutanyderus wilsoni* Alexander.
   Antennæ 17-segmented; tibiæ black with a broad central yellow ring; cell R_2 longer than its petiole. (Southern New South Wales). *Eutanyderus oreonympha* sp. nov.
4. Femora yellow, with only the tips blackened. (Southern Queensland). *Radinoderus terræ-reginæ* (Alexander).
   At least the fore femora conspicuously darkened at near midlength.... 5.
5. Wings broad, of normal conformation; wing bands wide, restricting ground color; an apical dark spot in cells Sc_1, R_1, and R_2; medial dark femoral rings conspicuous on all legs. (Northern New South Wales). *Radinoderus dorrigensis* Alexander.
   Wings relatively narrow, tips subfalcate; wing bands narrow; no dark spot at wing tip; median femoral bands of middle legs scarcely evident. (Western Australia). *Radinoderus occidentalis* (Alexander).

All of the previously described Australian species have been figured by the writer.[2] The most recent key to the tanyderid genera, with figures of the wing pattern and venation of the known Australian species, with the single exception of *Radinoderus occidentalis,* has been given by Dr. Inez W. Williams.[3]

[2] Alexander, C. P. The Tanyderidæ of Australia (Diptera). Proc. Linn. Soc. New South Wales **53** (1928) 367–374, figs. 1–4; Observations on the dipterous family Tanyderidæ. Proc. Linn. Soc. New South Wales **55** (1930) 221–230, pls. 5, 6; text fig. 1.

[3] Williams, Inez W. The external morphology of the primitive tanyderid dipteron, *Protoplasa fitchii* O. S., with notes on the other Tanyderidae. Journ. N. Y. Ent. Soc. **41** (1933) 1–35, pls. 1–8, figs. 1–38; text fig. 1.

The only species of the family described since the publication of the last-cited paper is *Protanyderus alexanderi* Kariya, from the Japanese Alps, Central Honshiu.[4]

Whether the Chilean genus *Araucoderus* Alexander can be maintained as distinct from *Eutanyderus* is rendered doubtful by the discovery of the new species described in this paper.

TIPULIDÆ

TIPULINÆ

PSELLIOPHORA ARDENS (Wiedemann).

Ctenophora ardens WIEDEMANN, Dipt. exot. 1 (1821) 20.

Pselliophora ardens OSTEN SACKEN, Berlin. Ent. Zeitschr. 30 (1886) 168.

One male, one female, Tjiangsana, Djampangs, western Java, November, 1936 (*Walsh*). The male agrees entirely with the descriptions and identified specimens, but the female has the wings almost uniformly deep saturated yellow, with a conspicuous dusky cloud at margin along tip of vein 1st A. In this specimen the wing tip, which is darkened in normal individuals, is concolorous with the remainder of the yellow ground.

PSELLIOPHORA LUCTUOSA de Meijere.

Pselliophora luctuosa DE MEIJERE, Tijd. voor Ent. 59 (1916) 199.

One male, Tjiangsana, Djampangs, western Java, November, 1936 (*Walsh*).

DOLICHOPEZA (OROPEZA) FOKIENSIS sp. nov. Plate 1, fig. 2; Plate 2, fig. 25.

General coloration of mesonotum gray, præscutum with four darker brownish gray stripes; antennæ of moderate length; basal flagellar segments bicolorous, dark with pale apices; legs with tibiæ and tarsi white; wings narrow, strongly suffused with brown, the brownish black stigma preceded and followed by restricted creamy yellow areas; cell 2d A narrow; male hypopygium with the sublateral portions of tergite with low triangular points; ninth sternite bearing oval yellow lobes that are densely provided with microscopic setulæ; ædeagus black, subtended by dusky phallosomic plates.

Male.—Length, about 11 millimeters; wing, 10.2; antennæ, about 3.4.

Frontal prolongation of head yellow above, blackened on sides; palpi with basal two segments dark brown, remaining segments

[4] Kariya, Shojiro. On the Family Tanyderidæ of Japan (Diptera). Mushi 8 (1935) 39–41, pl. 6, figs. 1–7.

black. Antennæ moderately elongate, as shown by measurements; scape and pedicel yellowish white; first flagellar segment pale brown; succeeding three segments brownish black, tip narrowly obscure yellow to produce a bicolored appearance; remaining segments uniformly blackened; flagellar segments subcylindrical, basal portion a trifle thicker; verticils subequal in length to segments, unilaterally arranged. Head light gray, somewhat darker gray on vertex, posterior vertex with a delicate capillary median vitta; anterior vertex wide.

Pronotum gray. Mesonotal præscutum gray, with four darker brownish gray stripes, intermediate pair separated by a line of the ground color, the two stripes confluent behind; posterior sclerites of notum blackened, sparsely pruinose, scutal lobes with cephalic-lateral portion darkened. Pleura obscure yellow, variegated with brownish gray on ventral sternopleurite, anepisternum, meron, and pleurotergite; dorsopleural membrane and pteropleurite pale. Halteres with stem yellow, knob broken. Legs with fore coxæ darkened, pale apically; remaining coxæ yellow, extreme bases darkened; trochanters yellow; femora brownish yellow, tips passing into brown; tibiæ and tarsi snowy white. Wings (Plate 1, fig. 2) with a strong brownish tinge, stigma very conspicuous, brownish black; prearcular and costal regions more suffused than remainder of ground; cell Sc yellow; restricted cream-yellow areas before and beyond stigma; veins brown. Wings narrower than in *shirakiella*. Venation: Rs straight, oblique, longer than basal section of R_{4+5}; cell 1st M_2 wider than in *shirakiella*, especially on basal portion; cell 2d A narrow.

Abdomen variegated obscure yellow and brown, basal rings brighter, more yellowish; a broken median series of longitudinal brown dashes on sternites, lacking on basal rings; hypopygium chiefly pale. Male hypopygium (Plate 2, fig. 25) with tergite, *9t*, extensive, median area slightly produced into a blackened plate the margin of which is weakly concave; sublaterally the tergal margin bears low triangular points. Ædeagus blackened, subtended by dusky plates, *p*, the apices of which are roughened. What appears to represent the ninth sternite, *9s*, bears two oval yellow lobes that are densely covered with microscopic pale setulæ.

Habitat.—China (Fukien).

Holotype, male, Gang-keu, altitude 1,900 feet, July 24, 1936 (*Gressitt*).

Generally similar to *Dolichopeza* (*Oropeza*) *shirakiella* (Alexander), of Formosa, differing especially in the longer antennæ, which are fully one and one-half as long as in *shirakiella*, with the flagellar segments correspondingly lengthened, and in the details of structure of the male hypopygium. The subgenus *Oropeza* had not been reported from China.

TIPULA (SCHUMMELIA) BICOLORATA sp. nov. Plate 1, fig. 3; Plate 2, figs. 26 and 27.

General coloration yellow, præscutum and scutum heavily patterned with polished black; pleura yellow, with a transverse brown girdle on episternum; knobs of halteres dark brown; femora yellow, tips blackened; wings bicolorous, basal two-thirds grayish subhyaline, distal third strongly infumed; abdominal segments in part bicolorous, yellow, caudal margins broadly dull black; male hypopygium with tergite complex in structure, dorsal plate bifid.

Male.—Length, about 9 millimeters; wing, 8.8; antennæ, about 3.5.

Frontal prolongation of head pale yellow above, slightly darker on sides; palpi with basal two segments pale brown, intermediate segment paler, terminal segment passing into black. Antennæ moderately elongate, as shown by measurements; scape and pedicel yellow; flagellum uniformly dark brown; terminal segment greatly reduced, oval; verticils shorter than segments. Head polished brown; anterior vertex wide.

Pronotum yellow, weakly darkened medially above. Mesonotal præscutum yellow, chiefly covered by three polished black stripes, interspaces very narrow and obscured, especially behind scutum similarly polished black; scutellum pale yellow, parascutella infuscated; mediotergite black centrally, paling to obscure brownish yellow on sides; pleurotergite brownish yellow. Pleura pale yellow, episternum more darkened, especially on anepisternum, to form a weak transverse girdle, crossing dorsopleural region and lateral borders of præscutum to disc of latter. Halteres with stem yellow, knob dark brown. Legs with coxæ and trochanters pale yellow; femora yellow, tips rather narrowly but conspicuously blackened, the amount subequal on all legs; tibiæ brown, tips passing into brownish black; tarsi black; claws with a single long basal tooth. Wings (Plate 1, fig. 3) bicolored, basal two-thirds grayish subhyaline, distal portion strongly infuscated, including all cells beyond cord except those immediately surrounding the darker brown, oval stigma, which

are whitish; wing tip similarly narrowly and vaguely whitened; axilla and adjacent regions of arculus restrictedly darkened; veins dark brown. Squama apparently naked. Venation: Rs oblique, straight, a little shorter than R_{2+3}; cell M_1 deep; cell 1st M_2 hexagonal; m-cu at near two-thirds the length of M_{3+4}.

Abdominal tergites bicolored, yellow, caudal margins broadly dull black; second tergite with base similarly blackened; outer tergites, including ninth, uniformly black; sternites yellow, second and third with posterior borders black, fourth to seventh, inclusive, uniformly yellow; eighth sternite black, ninth yellow. Male hypopygium (Plate 2, fig. 26) with the tergite, *9t*, distinct from the sternite, *9s*. Tergite (Plate 2, fig. 27, *9t*) profoundly split into two lobes, each with apex truncate, with coarse spines, margin roughened; from ventral face of tergite a longer plate forming two glabrous lobes, separated by a linear incision; lateral margins of lobes with a single series of black peglike spines; a long powerful spine on either side, these approximated at base to form a lyriform structure; a small curved fingerlike arm on side of plate near base, each tipped with a few short black spines. Dististyles, *d*, simple, the inner split nearly to base to form two separate lobes. Notch of ninth sternite with a small fleshy pale lobe on either side. Eighth sternite unarmed.

Habitat.—Eastern Borneo.

Holotype, male, Pelawau berar, Sangkoelirang district, in swampy forest, May, 1937 (*Walsh*).

Tipula (*Schummelia*) *bicolorata* is very distinct from the other regional species so far described, differing especially in the polished black color of the mesonotum, the bicolored wings, and the structure of the male hypopygium. The squama appears to lack the conspicuous setæ found in other members of the subgenus *Schummelia*, but the assignment appears to be correct.

NEPHROTOMA PARVA (Edwards).

Pachyrrhina parva EDWARDS, Ann. & Mag. Nat. Hist. VIII 18 (1916) 266, 267.

Described from Mount Ari, Formosa, altitude 8,000 feet, collected October 10, 1912, by Nitobe. A few specimens of both sexes from Hong San, Kiangsi, southeastern China, altitude 3,000 to 3,400 feet, June 24 to 29, 1936 (*Gressitt*), and from Tsin Leong San, eastern Kwangtung, China, altitude 2,750 feet, June 4, 1936 (*Gressitt*).

Allotype.—Length, about 10 millimeters; wing, 8.5.

Agreeing closely with the male in size and color. Central portions of scutal lobes a trifle darker than the ground, but not blackened; scutellum faintly darkened. Wings with cell Sc darkened; stigma a trifle darker than the ground. Cell M_1 with very short petiole or sessile, the character variable. Median line of abdominal tergites weakly infumed.

Allotype, female, Hong San, Kiangsi, altitude 3,150 feet, June 27, 1936 (*Gressitt*).

NEPHROTOMA NIGROSTYLATA Alexander.

Nephrotoma nigrostylata ALEXANDER, Philip. Journ. Sci. 57 (1935) 204–206.

Hitherto known only from Szechwan, western China. Several specimens of both sexes, Foochow, Fukien, southeastern China, May 1, 1936 (*Kellogg*).

LIMONIINÆ

LIMONIINI

LIMONIA (LIBNOTES) CITRIVENA sp. nov. Plate 1, fig. 4; Plate 2, fig. 28.

Thorax and abdomen uniformly orange; head brown; halteres yellow, outer half of knob black; femora yellow, tips broadly blackened; tibiæ and basal tarsal segments brownish yellow to yellow; wings pale yellow, veins deep orange-yellow throughout; Rs oblique; R_2 long, bending into R_{2+3} in an unusually long curve; anal veins convergent.

Male.—Length, about 11 millimeters; wing, 9.5.

Rostrum very small, brown; palpi reduced, black. Antennæ with scape brownish yellow, pedicel and flagellum black; flagellar segments subcylindrical to oval, with short apical necks; verticils nearly twice length of segments; terminal segment one and one-half length of penultimate, cylindrical. Holoptic or virtually so; head brown, posterior portion paler.

Thorax uniformly orange. Halteres yellow, outer half of knob black. Legs with coxæ and trochanters yellow; femora yellow, clearer at base, tips broadly blackened, the amount subequal on all legs, including about the distal sixth; tibiæ pale brownish yellow, tips narrowly and weakly darkened; tarsi with basal three segments yellow, outer segments dark. Wings (Plate 1, fig. 4) pale yellow, without stigma; cells C and Sc clearer yellow; veins deep orange-yellow. Macrotrichia on longitudinal veins beyond cord with exception of R_2. Venation: Sc long,

Sc_1 ending about opposite m-cu, Sc_2 at its tip; Rs oblique, vein R_1 beyond free tip of Sc_2 long, bending gently into R_{2+3}; cell 1st M_2 shorter than any veins beyond it, m-cu at near midlength; anal veins strongly convergent.

Abdomen, including hypopygium, uniformly deep orange. Male hypopygium (Plate 2, fig. 28) with tergite, *9t*, slightly narrowed outwardly, apex truncated or virtually so. Ventral dististyle, *vd*, fleshy, in area nearly equal to basistyle; a fleshy pale lobe on face, terminating in two strong setæ; rostral prolongation relatively slender, with a group of rostral spines near base, these apparently four in number in a close group but difficult to count in the unique type. Gonapophyses, *g*, with mesal apical lobe slender, a low flange on margin before apex. Ædeagus, *a*, unusually broad, bifid at apex.

Habitat.—Eastern Borneo.

Holotype, male, Pelawau berar, Sangkoelirang district, in swampy forest, May, 1937 (*Walsh*).

Limonia (*Libnotes*) *citrivena* is distinct in the uniform orange color of the body, in conjunction with the pale-yellow wings with orange veins.

LIMONIA (LIBNOTES) CROCEA CELESTIA subsp. nov.

Male.—Length, about 9 to 9.5 millimeters; wing, 10 to 11.

Characters as in typical *crocea* (Edwards)[5] of Siam, differing in the coloration of the thorax.

Anterior vertex reduced to a narrow strip, in width about one-fourth diameter of scape. Thorax uniformly orange, præscutum and scutum unmarked, surface shiny. Bases of fore femora a trifle brightened. Wings with arcular darkening not passing vein M behind. Male hypopygium with lobe of basistyle large. Dorsal dististyle a gently curved rod, tip decurved, surface of style with abundant delicate appressed setæ. Ventral dististyle relatively small, produced into a slender prolongation, the usual spines arising from base of prolongation, placed close together, their tips narrowed into hairlike points; from face of style near base of prolongation a strong tubercle tipped with a very long strong seta. Gonapophyses with mesal apical lobes slender, nearly straight, darkened.

Habitat.—Eastern Borneo.

Holotype, male, Pelawau berar, Sangkoelirang district, in swampy forest, May, 1937 (*Walsh*). Paratopotypes, 2 males.

[5] Ann. & Mag. Nat. Hist. VIII 17 (1916) 353.

Edwards [6] records this same race from two stations in lowland North Borneo.

LIMONIA (DICRANOMYIA) MESOSTERNATA (Alexander).

Dicranomyia mesosternata ALEXANDER, Ann. Ent. Soc. America 12 (1919) 329, 330.

Widespread in the Japanese Islands (Karafuto, Hokkaido, Honshiu). One male, Chengtu, Szechwan, western China, altitude 1,800 feet, May 6, 1936 (*Franck*). The three species, *Limonia* (*Dicranomyia*) *consimilis* (Zetterstedt), *L.* (*D.*) *mesosternata* (Alexander), and *L.* (*D.*) *mesosternatoides* (Alexander), are allied and are most readily told by differences in the structure of the male hypopygium, especially the ventral dististyles and gonapophyses.

LIMONIA (GERANOMYIA) TORTA sp. nov. Plate 1, fig. 5; Plate 2, fig. 29.

Rostrum relatively short, less than one-half length of body; mesonotal præscutum testaceous brown with two sublateral darker brown stripes, lateral margins brown; pleura pale yellow; femora obscure yellow with an ill-defined darker subterminal ring, tips narrowly yellow; wings faintly tinged with brown, costal portion more yellowish; an extensive pale-brown pattern, chiefly costal in distribution; dark areas at origin of Rs and fork of Sc widely separated; Sc long; costal fringe (male) long; male hypopygium with a single very powerful tubercle and spine at apex of rostral prolongation of ventral dististyle.

Male.—Length, excluding rostrum, about 5.5 millimeters; wing, 6.2; rostrum, about 2.

Female.—Length, excluding rostrum, about 6 millimeters; wing, 6.5; rostrum, about 2.

Rostrum relatively short, about equal in length to head and thorax combined, black throughout; palpi black. Antennæ black. Front and anterior vertex narrowly silvery, continued backward to occiput as a silvery median vitta, remainder of posterior vertex blackened.

Pronotum light brown, narrowly darkened laterally. Mesonotal præscutum with ground color pale testaceous brown, patterned with darker brown, including longitudinal narrow stripes occupying usual interspaces, extending entire length of præscutum; median dark vitta barely indicated; lateral borders of præscutum rather broadly darkened, in fresh specimens tinged

[6] Journ. Fed. Malay St. Mus. 16 (1931) 494.

with green; humeral region yellowish white, the color continued caudad between lateral darkened areas; scutal lobes weakly darkened, median region restrictedly pale; scutellum testaceous, parascutella a little darker; mediotergite brown. Pleura yellow, unmarked except for vague spots on dorsopleural membrane. Halteres dusky, stem more greenish. Legs with coxæ and trochanters testaceous yellow, with greenish tinges; femora obscure yellow, with an ill-defined dark subterminal ring, tips narrowly yellow; tibiæ and tarsi pale brown. Wings (Plate 1, fig. 5) with a faint brown tinge, ground color of costal region more yellowish; an extensive pale-brown pattern, including a series of about six costal areas, the second at the supernumerary crossvein in cell Sc, third at origin of Rs, fourth at fork of Sc, fifth stigmal, sixth at tip of vein R_3; in more heavily colored individuals areas two and three reaching vein M behind, in other specimens these areas more restricted; cord and outer end of cell 1st M_2 narrowly seamed with pale brown; very restricted pale-brown clouds at ends of veins Cu_1 and 2d A; veins brown, yellow in costal interspaces. Male with costal fringe long and conspicuous. Venation: Sc long, Sc_1 ending about opposite four-fifths to five-sixths length of Rs, Sc_2 at its tip; a supernumerary crossvein in cell Sc; cell 1st M_2 subequal in length to vein M_{1+2} beyond it; m-cu close to fork of M; cell 2d A moderately wide.

Abdominal tergites and hypopygium brown; sternites yellow. Male hypopygium (Plate 2, fig. 29) with tergite, *9t*, rather deeply notched. Basistyle, *b*, with ventromesal lobe small, slightly and unequally bilobed. Dorsal dististyle a powerful curved hook. Ventral dististyle, *vd*, of moderate size, larger than basistyle; rostral prolongation very strong and powerful, close to apex with a very long tubercle that merges at near two-thirds length into a single powerful spine or two unequal, partially fused spines; combined spine and tubercle in length exceeding dorsal dististyle. Gonapophyses, *g*, with mesal apical lobe slender, curved.

Habitat.—Assam (Khasi Hills).

Holotype, male, Cherrapunji, altitude, 4,000 feet, May, 1936 (*Sircar*). Allotopotype, female. Paratopotype, female.

Limonia (*Geranomyia*) *torta* is very different from the other regional species of the subgenus in the short rostrum, the pattern of the præscutum and pleura, wing pattern, long costal fringe in male, and in the structure of the male hypopygium. The costal fringe is somewhat as in the otherwise entirely distinct *L.* (*G.*) *longifimbriata* Alexander (Philippines). The

structure of the male hypopygium is most similar to that of *L.* (*G.*) *baliana* Alexander (Bali) which has the costal fringe short and all details of coloration and venation distinct.

LIMONIA (GERANOMYIA) FUMIMARGINATA VACIVA subsp. nov.

Female.—Length, excluding rostrum, about 6.3 to 6.7 millimeters; wing, 6.5 to 7; rostrum, about 2.2 to 2.4.

Close to the typical form, distinguished especially by the subterminal, slightly darkened femoral ring and the more heavily patterned wings. Antennal flagellum pale brown, much paler than basal segments. Præscutal stripes brownish black, median stripe widest opposite pseudosutural foveæ. Femora with an ill-defined pale-brown subterminal ring, tips clear yellow. Wings with the pattern quite distinct from that of the typical form; dark costal areas with the pale centers much more restricted, the dark margins correspondingly widened; dots and marbling of basal field more abundant and irregular, invading cells C and Sc and interpolating darkenings between first and second (h and supernumerary crossvein in cell Sc) and second and third (origin of Rs) major costal areas.

Habitat.—Assam (Khasi Hills).

Holotype, female, Cherrapunji, altitude 4,000 feet, May, 1936 (*Sircar*). Paratopotype, female.

HELIUS (HELIUS) PAVONINUS sp. nov. Plate 1, fig. 6; Plate 2, fig. 30.

General coloration black; halteres yellow; legs yellow, tips of femora conspicuously black; wings brown, patterned with large, pale cream-colored areas, including two major spots just beyond one-third length of wing, constricting ground color at this point; other pale areas beyond cord.

Male.—Length, about 6 millimeters; wing, 6 to 6.5.

Female.—Length, about 6.5 to 7 millimeters; wing, 6 to 6.5.

Rostrum black, slightly longer than remainder of head; palpi black. Antennæ short, about one and one-half length of rostrum; scape black, pedicel brownish black, flagellum brown; basal flagellar segments oval, terminal segment elongate; verticils about equal in length to segments. Head brownish black, front and orbits more grayish; anterior vertex narrow.

Pronotum brownish black. Mesonotal præscutum reddish brown, with three blackish stripes, median stripe long and complete, lateral stripes short and inconspicuous; lateral margins of præscutum blackened; posterior sclerites of notum brownish black. Pleura black. Halteres with stem pale or weakly in-

fumed, extreme base and knob clear yellow. Legs with the coxæ brownish black, fore pair a little brightened at tip; trochanters yellow, posterior pair more darkened; femora light yellow, tips conspicuously (0.6 to 0.7 millimeters, or about distal eighth or ninth) and abruptly black; tibiæ and tarsi yellow, terminal segments darker; claws simple. Wings (Plate 1, fig. 6) with a strong brown suffusion, handsomely patterned with pale cream-yellow, as follows: Major areas in cell R before origin of Rs and opposite this in outer ends of cells Cu and 1st A, restricting dark ground color at this level to cell M; a nearly complete but narrow pale band beyond cord, including broad bases of outer radial cells, center of cell 1st M_2, and outer end of cell M_4; isolated smaller yellow areas before stigma in cell R_1 and beyond tip of vein R_3 in cell R_3; anterior prearcular region, with cells C and Sc clear yellow; veins brown, yellow in clear areas. Anterior branch of Rs with a variable number of macrotrichia, in cases these lacking; other branches of R and M, with the exception of M_4, with trichia. Venation: Sc relatively long, Sc_1 ending shortly before fork of Rs, Sc_2 near its tip; branches of Rs strongly divergent, cell R_3 at margin thus very wide; m-cu at near one-third to one-half length of cell 1st M_2.

Abdomen black, hypopygium a little more reddish brown. Male hypopygium (Plate 2, fig. 30) with outer dististyle, *od*, relatively stout, outer tooth bearing a tiny lateral spinule before apex; inner tooth elongate. Lateral tergal lobes, *9t*, appearing as unusually large expanded blades.

Habitat.—Assam (Khasi Hills).

Holotype, male, Cherrapunji, altitude 4,000 feet, May, 1936 (*Sircar*). Allotopotype, female, pinned with type. Paratopotypes, 7 of both sexes.

Helius (*Helius*) *pavoninus* is entirely different from all other described species of the genus, especially in the handsomely patterned wings.

HELIUS (HELIUS) CTENONYCHA sp. nov. Plate 1, fig. 7; Plate 2, fig. 31.

General coloration of præscutum obscure yellow, with a narrow but conspicuous dark-brown median stripe; head dark gray; antennæ relatively short; legs black, tarsi paling to yellow; claws conspicuously toothed; wings strongly infumed, costal border broadly darker brown to wing apex; Sc_1 ending nearly opposite r-m; cells R_2 and R_3 at wing margin subequal in extent; cell

1st M_2 rectangular, one and one-half as long as wide; m-cu at or very close to fork of M; male hypopygium with outer dististyle bearing a straight lateral spine some distance before tip; lateral lobes of tergite appearing as very flattened blades with obtusely rounded tips.

Male.—Length, about 6 millimeters; wing, 6 to 6.5.

Female.—Length, about 7 millimeters; wing, 6.2 to 6.8.

Rostrum black, about equal in length to remainder of head; palpi black. Antennæ about as long as head, including rostrum; scape and flagellum black, pedicel more brownish; flagellar segments oval, beyond fifth or sixth becoming more elongate. Head dark gray, with conspicuous erect to proclinate black setæ.

Cervical sclerites black. Pronotum and præscutum obscure yellow, narrowly but conspicuously dark brown medially; posterior sclerites of notum more uniformly dark brown. Pleura yellow, mesepisternum in cases weakly darkened. Halteres dark brown, base of stem restrictedly yellow. Legs with coxæ and trochanters yellow; femora black, bases very narrowly obscure yellow, more evident on forelegs; tibiæ and basitarsi black, outer tarsal segments paling to yellow; claws large, yellow, each with three long conspicuous teeth, outer tooth largest. Wings (Plate 1, fig. 7) strongly infumed, broad costal margin to wing tip still darker brown, stigma not further differentiated; veins dark brown. Costal fringe short. Venation: Sc relatively long, Sc_1 ending nearly opposite r-m, Sc_2 a short distance from its tip; branches of Rs very gradually diverging from one another; cells R_2 and R_3 at margin subequal; cell 1st M_2 rectangular, one and one-half as long as wide; m-cu at or very close to fork of M.

Abdominal tergites brown, caudal borders a little darker; basal sternites obscure brownish yellow, darker laterally; subterminal segments dark brown; hypopygium a little brightened. Male hypopygium (Plate 2, fig. 31) with the basistyle, *b,* simple, with more abundant setæ on mesal face than on outer. Outer dististyle, *od,* shorter than inner, sickle-shaped, with a conspicuous lateral spine some distance from tip. Inner dististyle, *id,* with distal half unusually long and slender. Lateral lobes of tergite, 9*t,* appearing as very flattened blades, tips oval.

Habitat.—Eastern Borneo.

Holotype, male, Pelawau berar, Sangkoelirang district, in swampy forest, May, 1937 (*Walsh*). Allotopotype, female. Paratopotypes, 1 male, 1 female. Paratypes, 6 males, Batan bessi, Sangkoelirang district, May, 1937 (*Walsh*).

The most similar species is *Helius* (*Helius*) *fumicosta* Edwards (Malay Peninsula) which differs in the shorter rostrum, in the shortened basal flagellar segments, in the uniformly reddish brown thorax, and in the venational details, as the short cell 1st M_2, with m-cu shortly beyond its base. The long teeth on the claws in the present species are very conspicuous.

HELIUS (HELIUS) NIGRICAPELLA sp. nov. Plate 1, fig. 8; Plate 2, fig. 32.

Allied to *nigriceps;* general coloration of mesonotum almost uniformly dark brown; antennæ short, flagellum brown; pleura yellowish brown, blackened dorsally; wings grayish, cells C and Sc with stigma more infuscated; Sc_1 ending shortly before fork of Rs; m-cu about one-fourth its length before fork of M; male hypopygium with outer dististyle terminating in two very short points; inner dististyle with apical portion broad; lateral lobes of tergite with a narrow head, margin produced into a single acute recurved point.

Male.—Length, about 6 millimeters; wing, 5.5; antennæ, 1.

Rostrum and palpi black, the former subequal in length to remainder of head. Antennæ relatively short; scape and pedicel black, flagellum brown; basal flagellar segments oval, outer segments more elongate; basal flagellar segment with conspicuous basal pedicel, succeeding segments with this much shorter; terminal segment one and one-fourth as long as penultimate; verticils shorter than segments, unilaterally distributed. Head black; anterior vertex reduced to a narrow strip.

Mesonotum almost uniformly dark brown. Pleura with dorsal portion occupied by a blackened stripe that also includes the pleurotergite; ventral pleurites paler, yellowish brown. Halteres black. Legs with coxæ and trochanters obscure yellow; femora black, bases of fore pair restrictedly paler; tibiæ and basitarsi black, outer tarsal segments paler; claws with basal spines. Wings (Plate 1, fig. 8) grayish, cells C and Sc, with the stigma, more infuscated; margin of outer radial field slightly darkened; veins brown. Costal fringe (male) moderately long. Venation: Sc relatively long, Sc_1 ending shortly before fork of Rs, Sc_2 close to its tip; branches of Rs gently divergent, cell R_2 at margin very narrow, about one-fifth that of cell R_3; cell 1st M_2 small, irregularly pentagonal, much shorter than any of veins beyond it; m-cu about one-fourth its length before fork of M; cell 2d A relatively wide.

Abdomen black, hypopygium a little brightened. Male hypopygium (Plate 2, fig. 32) with mesal face of basistyle, *b*, with

abundant coarse setæ but otherwise unarmed. Outer dististyle, *od*, relatively short, gently curved, at apex split into two very short cultriform points. Inner dististyle, *id*, longer, distal third more flattened, only slightly narrower than base. Lateral lobes of tergite, *9t*, with expanded apex unusually narrow, margin produced into a single acute recurved point.

Habitat.—Eastern Borneo.

Holotype, male, Pelawau berar, Sangkoelirang district, in swampy forest, May, 1937 (*Walsh*).

Helius (*Helius*) *nigricapella* is closely allied to *H.* (*H.*) *nigriceps* Edwards. I possess a paratype of this latter species through the friendly interest of Doctor Edwards; the species differs in the venation, especially the wider radial field and more divergent branches of Rs, although cell R_2 at margin is similarly very narrow. What I have determined as *nigriceps* from Sumatra differs further in the simple claws and in the structure of the male hypopygium, especially in the narrow apex of the inner dististyle and the entirely different conformation of the apices of the lateral tergal lobes.

HEXATOMINI

GYNOPLISTIA (GYNOPLISTIA) ALBIZONATA sp. nov. Plate 1, fig. 9.

Entire thorax pale orange yellow, opaque; head black; halteres yellow; legs black, all tibiæ with a narrow white ring at near basal third; wings blackish, prearcular region abruptly clear yellow; veins of outer radial field with abundant macrotrichia; cell M_1 present; abdomen with segment one and basal ring of segment two yellow, remaining segments blackened basally, caudal margins gray; subterminal segments and genital shield black.

Female.—Length, about 15 millimeters; wing, 13.

Rostrum and palpi black. Antennæ 17-segmented, black throughout; formula (female) 2+3+4+8; branch of first flagellar segment short and obtuse; second branch about twice the segment; longest branch (about flagellar segment three or four) about two and one-half times the segment; penultimate segment indistinctly separated from terminal. Head transverse, black.

Entire thorax pale orange-yellow, surface opaque. Halteres yellow. Legs with coxæ and trochanters orange; femora black, extreme bases of fore pair yellow, this color even more reduced on remaining femora; tibiæ black with a narrow white ring at near basal third, narrowest (about 0.5 to 0.6 millimeter) on forelegs, widest (about 1.1 to 1.2 millimeters) on posterior

legs; vestiture of annuli similarly whitened; tarsi black. Wings (Plate 1, fig. 9) relatively broad, deeply suffused with black, more saturated in costal portion; wing base to level of arculus bright yellow, clearly delimited; veins dark brown, yellow in prearcular field. Macrotrichia of outer radial veins abundant, fewer and more scattered on veins M_1 and M_2, lacking on M_3 and M_4. Venation: Sc_2 projecting beyond level of Sc_1, ending shortly beyond level of origin of R_{2+3}; R_{2+3+4} short, subequal to or shorter than R_2; petiole of cell M_1 about two-thirds the cell; m-cu at near midlength of cell 1st M_2.

Abdomen with segment one and basal ring of segment two clear yellow; remainder of tergite two and succeeding tergites blackened basally, caudal margins broadly blue-gray, on the subterminal segments more uniformly blackened; sternites chiefly blackened, caudal margins of segments narrowly gray; shield of ovipositor dull black; cerci stout, flattened-compressed, black, tips horn-yellow; hypovalvæ uniformly blackened.

Habitat.—New Guinea (Morobe District).

Holotype, female, Mount Misim, altitude 6,400 feet, March (*Stevens*); Museum of Comparative Zoölogy, Cambridge, Massachusetts, through Dr. Nathan Banks.

Gynoplistia (*Gynoplistia*) *albizonata* is very different from other species of the genus in the Papuan fauna. *G.* (*G.*) *insolita* Walker, of Salwatty, has somewhat similar white rings on the tibiæ but is entirely different in other respects.

HEXATOMA (ERIOCERA) PERORNATA sp. nov. Plate 1, fig. 10.

Allied to *lunata;* general coloration ochreous and dark brown; antennæ (male) greatly elongated, approximately four times length of body; wings grayish subhyaline, conspicuously patterned with brown and yellow, latter color appearing as seams to certain veins; cell R very wide at outer end; cell M_1 present; m-cu at fork of M; abdominal segments yellow, intermediate tergites with caudal borders narrowly blackened.

Male.—Length, 11 to 12 millimeters; wing, 12.5 to 13.5; antennæ, about 45.

Rostrum greatly reduced in size, pale brown; palpi black, porrect. Antennæ (male) greatly elongated, approximately four times length of body, as shown by measurements; scape enlarged, obscure yellow, streaked above with a dusky line; pedicel yellow, darkened beneath; flagellum brownish black to black, segment one restrictedly paler at base; all flagellar segments with a uni-

laterally arranged series of outwardly directed spines, more numerous on basal segments, becoming sparse and scattered on outer segments. Vertical tubercle unusually large and inflated, obscure yellow, with dense long pale hairs; antennal fossa involving anterior face of tubercle; posterior portion of head ochreous yellow.

Mesonotal præscutum variegated with ochreous and dark brown, the pattern consisting of two brown stripes on anterior half, their outer margins thence directed laterad and forming outer borders of usual præscutal stripes, median region behind thus chiefly pale, slightly more infumed before suture; scutum grayish ochreous, lobes variegated with brown; scutellum light gray, parascutella darker; postnotum pale ochreous. Mesonotum with long, coarse, chiefly pale-brown hairs, longest and most conspicuous on præscutum, involving stripes as well as interspaces. Pleura chiefly pale, variegated with brown on anepisternum and sternopleurite. Halteres yellow, small knobs darkened. Legs with coxæ darkened; trochanters reddish brown; remainder of legs yellow, tips of tibiæ and outer tarsal segments darkened; legs relatively short and stout, conspicuously hairy; claws with basal spine. Wings (Plate 1, fig. 10) with ground color grayish subhyaline, conspicuously patterned with brown and yellow, somewhat as in *ornata;* brown pattern including prearcular field, bases of cells R and M, anterior border of cell R, virtually all of R_1, and basal half of R_4; cells C, Sc, Sc_1, R_2, and R_3 brown, with conspicuous whitish streaks; a dark-brown seam continued along vein R_5 to margin; cord and adjoining portions of veins M, M_{1+2}, and m conspicuously bordered by yellow, this, in turn, similarly margined with brown; tips of veins R_{1+2}, R_3, and R_4 similarly bordered by yellow, like basal half of vein M where it traverses the darkened basal cells; anal cells more infuscated, especially in the axilla and as a seam on outer half of vein 2d A. Costal fringe short but abundant; veins beyond cord virtually glabrous; a scattered series of small trichia for almost the entire length of outer section of vein R_5. Venation: Much as in *ornata* and *lunata;* Rs very long, on basal third paralleling vein R_1, thence very gradually diverging, but cell R_1 unusually narrow at outer end; vein M arched at midlength; cell R at outer end of unusual width, as in *ornata* and *lunata;* cell M_1 present; vein m very long, oblique; basal section of M_{1+2} long and strongly arcuated, inner end of

cell 1st M_2, thus lying proximad of other elements of cord; m-cu at fork of M, shorter than distal section of Cu_1; cell 2d A wide.

Abdomen short and arcuate, as common in males of this genus having elongate antennæ; segments yellow, intermediate tergites narrowly and inconspicuously bordered with black, most evident on posterior margin of tergite two; outer segments and hypopygium more uniformly infuscated; basal tergites whitish pruinose, narrowly darkened medially; abdomen with long setæ, most conspicuous on sides and toward outer end.

Habitat.—Eastern Borneo.

Holotype, male, Pelawau berar, Sangkoelirang district, in unending swampy forest, May, 1937 (*Walsh*). Paratopotype, 1 male.

This fly and the species next described as *Hexatoma* (*Eriocera*) *perlunata* sp. nov. are unquestionably most nearly allied to *H.* (*E.*) *lunata* (Westwood) and *H.* (*E.*) *ornata* (Enderlein), despite the possession of cell M_1. The four species form a very isolated group, with a distribution ranging from the Malay Peninsula and Sumatra to Borneo. All are well-distinguished by the greatly elongated antennæ of the male and by certain venational features, as the position of Rs, which on its basal portion lies parallel to vein R_1, and by the unusual width of cell R at its outer end. Edwards[7] has well discussed the interrelationships existing between *lunata* and *ornata*.

HEXATOMA (ERIOCERA) PERLUNATA sp. nov. Plate 1, fig. 11.

Female.—Length, about 13 millimeters; wing, 10; antennæ, about 2.

Closely allied to *perornata* sp. nov., but differing in virtually every detail of color.

Rostrum brown; palpi black. Antennæ 7-segmented, very short; scape pale, pedicel and flagellar segments gradually smaller outwardly, last subglobular. Vertical tubercle moderately enlarged, deep chestnut-brown; head darker behind.

Thorax almost uniformly dull black; setæ short and sparse. Halteres black throughout. Legs with coxæ and trochanters black; fore femora yellow with about distal fourth brownish black; remaining femora almost uniformly infuscated, tips a little more blackened; tibiæ black, extreme bases narrowly orange; tarsi black; claws simple. Wings (Plate 1, fig. 11) with

[7] Ann. & Mag. Nat. Hist. IX 8 (1921) 68, 70, 71, 93, 94.

the restricted ground color whitish subhyaline, remainder chiefly dark brown, including all of wing before cord except anal cells, a lunule of the ground color in cells R and M before cord, and very restricted yellow spots, as follows: h, origin of Rs, fork of Sc, cord, and tips of veins R_{1+2}, R_3, and R_4; beyond cord, the whitish ground involving the broad outer ends of cells R_4 to M_4, inclusive, interrupted by a broad dark seam along vein R_5 to margin or nearly so; cell Cu dark except for a pale spot nearly at outer end; cell 1st A chiefly brownish gray; cell 2d A darkened, with an obscure yellow spot before midlength, crossing vein 2d A into cell 1st A. Venation: Almost as in *perornata*.

Abdomen black, vaguely brightened by obscure yellow areas on intermediate tergites. Cerci long and slender, horn-yellow.

Habitat.—Eastern Borneo.

Holotype, female, Pelawau berar, Sangkoelirang district, in swampy forest, May, 1937 (*Walsh*). Paratopotype, female.

Despite the entirely differing general appearance, the present fly is very closely related to *Hexatoma* (*Eriocera*) *perornata* sp. nov., and the possibility is not excluded that the two names represent the sexes of a single species. If such should prove to be the case, the sexual dichroism would be extreme for species within the genus.

HEXATOMA (ERIOCERA) NIMBIPENNIS sp. nov. Plate 1, fig. 12.

Belongs to the *verticalis* group; general coloration brownish black to black; antennæ (male) elongate, approximately four times length of body; scape and pedicel chestnut yellow, flagellum black; flagellar segments with numerous erect spines; vertical tubercle black; præscutum without stripes; halteres brownish black throughout; femora yellow, base and apex darkened; wings with a strong brownish tinge; stigma oval, darker brown; macrotrichia on veins beyond cord sparse or lacking; veins R_{1+2}, R_2, and R_{2+3} subequal; R_{1+2} in longitudinal alignment with R_1; m-cu at fork of M; abdomen and hypopygium dull black.

Male.—Length, about 11 millimeters; wing, 13; antennæ, about 45; flagellar segment one, 12; flagellar segment two, 13.

Rostrum short, black; palpi black. Antennæ (male) very long, approximately four times length of body; scape and pedicel chestnut yellow, flagellum black; flagellar segments with numerous erect spines, becoming more sparse and scattered on outer segments. Head brownish black; vertical tubercle very large and bulbous, with conspicuous erect pale setæ.

Mesonotum brownish black to dull black, præscutum without evident stripes; interspaces with long erect white setæ. Pleura dull black, very sparsely pruinose. Halteres brownish black throughout. Legs with coxæ and trochanters brownish black; femora yellow, base and apex darkened; tibiæ dark brown; tarsi black; claws with tooth at extreme base. Wings (Plate 1, fig. 12) with a strong brown tinge, cell Sc a little more yellowish; stigma oval, darker brown than the ground; veins brown, Sc, Cu, and veins near wing base more yellowish; vein C more incrassated opposite stigmal region. Costal macrotrichia short but abundant; trichia lacking on veins beyond cord, with exception of a restricted series on distal section of vein R_5. Venation: R_{1+2}, R_2, and R_{2+3} all short, subequal in length; R_{1+2} straight, in virtual longitudinal alignment with R_1, not upcurved to costa, as common in the group; Rs about three times R_{2+3+4}; m-cu at fork of M.

Abdomen, including hypopygium, dull black.

Habitat.—Western Java.

Holotype, male, Tjikarang, Djampangs, November, 1936 (*Walsh*).

Hexatoma (*Eriocera*) *nimbipennis* is allied to *H.* (*E.*) *verticalis* (Wiedemann), differing especially in the almost uniform black color of the body and halteres, with no præscutum stripes.

HEXATOMA (ERIOCERA) NIMBIPENNIS STYGIPES subsp. nov.

Female.—Length, about 15 millimeters; wing, 12.

Similar to the typical form, differing as follows: Antennæ and legs entirely and uniformly black. Wings more uniformly blackened, costal region and seams along radial veins darker; stigma scarcely differentiated against the ground.

Habitat.—Western Java.

Holotype, female, Bibidjilan, Djampangs, November, 1936 (*Walsh*).

HEXATOMA (ERIOCERA) ENAVATA sp. nov. Plate 1, fig. 13.

Belongs to the *verticalis* group; general coloration brown; antennæ (female) 10-segmented, scape and pedicel yellow, flagellum black; wings with a weak brown tinge; stigma pale brown; macrotrichia of veins beyond cord reduced in number; R_3 short, about two-thirds as long as R_{2+3+4}; cell 1st M_2 about equal in length to vein M_{1+2} beyond it; valves of ovipositor elongate.

Female.—Length, about 9 millimeters; wing, 7.5.

Rostrum very reduced, testaceous; palpi short, brown. Antennæ (female) 10-segmented; scape and pedicel yellow, flagellum black; basal flagellar segment much more incrassated than those following, especially on basal half; flagellar segments two and three subequal in length; succeeding segments gradually decreasing in length. Head brown; vertical tubercle inconspicuous.

Mesonotum almost uniformly dark brown, posterior sclerites more pruinose; setæ of præscutum almost lacking, reduced to a few microscopic ones near suture. Pleura dark brown, sparsely pruinose. Halteres infuscated. Legs with coxæ and trochanters brown; femora obscure yellow to brownish yellow, tips weakly darkened; tibiæ and tarsi brownish black. Wings (Plate 1, fig. 13) with a weak brown tinge; stigma oval, pale brown; veins brown, C and Sc more yellowish. Macrotrichia of veins beyond cord virtually confined to a complete series on vein R_5. Venation: Sc_1 ending about opposite r-m, Sc_2 a short distance from tip; Rs long, about twice R_{2+3+4}; R_2 a little longer than R_{1+2}, placed before the fork, so a short element R_{3+4} is present; R_3 about two-thirds as long as R_{2+3+4}; cell 1st M_2 about equal in length to vein M_{1+2} beyond it; m reduced; m-cu close to fork of M, longer than distal section of Cu_1.

Abdominal tergites dark brown; basal sternites a little brightened; genital shield yellow. Ovipositor with valves long and slender, dark brown.

Habitat.—Western Java.

Holotype, female, Tjimerang, Djampangs, October, 1936 (*Walsh*).

By Edwards's key to the Old World species of *Eriocera* [8] the present fly runs to *Hexatoma* (*Eriocera*) *pusilla* Alexander, of Tropical Africa, which somewhat resembles the present species in general appearance but differs fundamentally in the short fleshy valves of the ovipositor. Whether the antennæ of the male sex of the present insect are elongate remains a questionable point, but from the reduced vertical tubercle of the female it seems very possible that this is not the case.

HEXATOMA (ERIOCERA) RUFICAUDA (Edwards).

Eriocera ruficauda EDWARDS, Journ. Fed. Malay St. Mus. 16 (1931) 502, 503.

The unique type was taken from Bettotan, at low altitudes in British North Borneo. A female from Pelawau berar,

[8] Ann. & Mag. Nat. Hist. IX 8 (1921) 70–78.

Sangkoelirang district, East Borneo, taken May, 1937, by Mrs. Walsh, is very similar to the type, differing in minor regards only.

Antennæ (female) 11-segmented; basal segments obscure yellow, outer segments more darkened; antennæ shorter than combined head and thorax. Trochanters and femoral bases pale. Venation: R_{2+3} one and one-half as long as R_{2+3+4} and fully four times R_2 alone; petiole of cell M_1 about twice the cell.

HEXATOMA (ERIOCERA) AZUREA sp. nov. Plate 1, fig. 14.

General coloration velvety black; legs black, femora broadly bright yellow on basal portions; wings black, prearcular field abruptly yellow; Rs relatively short, less than R; m-cu at outer end of cell 1st M_2; abdomen velvety black with conspicuous deep blue shiny rings on tergites two to six, inclusive; genital shield black.

Female.—Length, about 18 millimeters; wing, 15.5.

Rostrum and palpi black. Antennæ with scape and pedicel black; flagellum broken. Head black, sparsely dusted with gray; vertical tubercle low, entire.

Thorax uniformly velvety black; vestiture of præscutum moderately long but sparse. Halteres uniformly dark brown. Legs with coxæ and trochanters brownish black; femora bright yellow on basal third to half, remainder of legs uniformly black. Wings (Plate 1, fig. 14) black, prearcular field abruptly and conspicuously light yellow; paler longitudinal streaks in cells R, M, and 1st A; veins brown, yellow in prearcular field. Macrotrichia of outer radial veins relatively abundant except at ends of veins; no trichia on outer medial branches. Venation: Rs relatively short, less than twice basal section of R_5 and shorter than R; R_{2+3+4} shorter than basal section of R_5; R_{1+2} long, one and one-half as long as either R_{2+3+4} or R_{2+3}; cell M_1 lacking; m-cu at outer end of cell 1st M_2, shorter than distal section of Cu_1.

Abdomen velvety black, with deep blue shiny rings at midlength of tergite two and on bases of tergites three to six, inclusive; genital shield black; cerci elongate, very gently upcurved, horn-colored.

Habitat.—Mindanao.

Holotype, female, Zamboanga; in the Museum of Comparative Zoölogy, Cambridge, Massachusetts, through gift of B. P. Clark.

Hexatoma (*Eriocera*) *azurea* is most nearly allied to *H.* (*E.*) *chalybeicincta* (Alexander), likewise from Mindanao, differing

especially in the brightened femoral bases, yellow wing base, unusually short Rs, and long R_{1+2}. The brevity of Rs approaches the condition found in *H.* (*E.*) *selene* (Osten Sacken); in all other respects the present species is a very different fly.

HEXATOMA (ERIOCERA) VIRIDIVITTATA sp. nov.

General coloration of thorax dull black, præscutum with three polished metallic green stripes; antennæ with basal flagellar segments yellow; femora yellow, tips broadly black, tibiæ dark brown throughout; wings dark brown, prearcular region pale yellow, discal area whitish; genital shield orange.

Female.—Length, about 18 millimeters; wing, 14.

Rostrum and palpi black. Antennæ (female) 9-segmented; scape and pedicel dark brown; basal four flagellar segments yellow, terminal three segments dark brown; flagellar segments gradually decreasing in length, first about one and one-half times length of second; terminal segment one and one-half times length of penultimate. Head dull black, sparsely pruinose, with black setæ; vertical tubercle low.

Pronotum black. Mesonotal præscutum dull black with three broad polished metallic green stripes, interspaces narrowed behind; setæ of interspaces relatively sparse but long; posterior sclerites of notum brownish black, centers of scutal lobes more greenish. Pleura dull black. Halteres brownish black. Legs with coxæ and trochanters black; femora light yellow, tips conspicuously blackened, on fore and middle legs including distal third; posterior legs broken; tibiæ dark brown; tarsi black. Wings strongly infumed, prearcular region broadly light yellow; a more whitish discal blotch in cells R_1, R, and M; most cells of wing with somewhat paler central streaks to produce a slightly streaked appearance; veins stout, much more so than in *glabrivittata*, brown, yellow in pale areas. Outer radial branches with macrotrichia. Venation: Rs relatively long, about one and one-half as long as R; R_{1+2} subequal to R_{2+3}; R_{2+3+4} shorter than basal section of R_5; R_2 vertical; cell 1st M_2 relatively small, shorter than any of veins beyond it; cell M_1 lacking; m-cu at near midlength of cell 1st M_2, about one and one-half times length of distal section of Cu_1.

Abdomen with first tergite velvety black; tergites two to seven almost entirely nacreous brown, with bluish reflections, caudal borders of segments narrowly darkened, opaque; sternites more reddish brown; genital shield orange; cerci elongate, slender, dark brown on basal half, distal ends yellow.

Habitat.—Mindanao.

Holotype, female, Zamboanga; in the Museum of Comparative Zoölogy, Cambridge, Massachusetts, through gift of B. P. Clark.

Closest to *Hexatoma* (*Eriocera*) *glabrivittata* Alexander (northern Luzon), differing in the metallic green præscutal stripes, orange genital shield, stout wing veins, and details of venation, as the longer and narrower cell 1st M_2.

HEXATOMA (ERIOCERA) DISJUNCTA sp. nov. Plate 1, fig. 15.

General coloration black, thorax dull black; antennæ (female) 8-segmented, flagellar segments yellowish brown; terminal segment about two-thirds penultimate; setæ of præscutal interspaces relatively inconspicuous; halteres and legs black; wings strongly tinged with blackish, cell 1st A paler; two disconnected white areas before cord, one in outer end of cell R_1, second crossing outer ends of cells R and M; wing tip narrowly yellow; veins R_{1+2} and R_{2+3+4} subequal; abdomen black, tergites subnitidous, with narrow velvety black posterior borders that become even narrower and finally evanescent on outer segments; eighth and succeeding abdominal segments orange.

Female.—Length, about 13 millimeters; wing, 10.

Rostrum and palpi black. Antennæ (female) 8-segmented; scape and pedicel black, outer flagellar segments more yellowish brown; flagellar segments gradually decreasing in length, last about two-thirds penultimate. Head dull black.

Mesonotum uniformly dull black; setæ of interspaces very short on cephalic half of præscutum, longer but still relatively inconspicuous behind. Pleura black. Halteres black throughout. Legs entirely black. Wings (Plate 1, fig. 15) with a strong blackish tinge, cell 1st A much paler, more grayish; prearcular region, base of cell C, and cell 2d A somewhat paler than ground; two entirely disconnected white discal spots of moderate size, one in outer end of cell R_1, the other occupying both cells R and M across distal end of vein M; wing tip narrowly but conspicuously pale yellow, extending from cell R_2 to 2d M_2; veins dark brown. Longitudinal veins beyond cord with abundant macrotrichia. Venation: Sc_1 ending opposite r-m; R_{1+2} relatively long, subequal to R_{2+3+4}, and approximately two and one-half to three times R_{2+3}; cell M_1 lacking; inner end of cell 1st M_2 strongly arcuated; m-cu at near four-fifths length of cell 1st M_2; distal section of Cu_1 rather strongly curved to margin but in longitudinal alignment with basal section.

Abdomen black, eighth and succeeding segments (female), including genital shield and valves of ovipositor, orange; tergites subnitidous, caudal margins of segments narrowly more velvety black, on intermediate segments including distal fourth or fifth of exposed portions of segments, becoming narrower on outer segments, segments five to seven almost entirely subnitidous.

Habitat.—Eastern Borneo.

Holotype, female, Pelawau berar, Sangkoelirang district, in swamp forest, May, 1937 (*Walsh*).

By Edwards's key to the Old World species of *Eriocera* [9] the present fly runs to *Hexatoma* (*Eriocera*) *leucotela* (Walker) of Singapore, disagreeing in the wing pattern and venational details. Edwards's figure of the type specimen of *leucotela*,[10] compared to the present fly, shows a single pale discal area, a much wider whitened apex, and both anal cells paler than the ground.

HEXATOMA (ERIOCERA) JUXTA sp. nov. Plate 1, fig. 16.

Allied to *disjuncta;* general coloration dull black; antennæ 8-segmented in both sexes; halteres and legs black; wings strongly suffused with blackish; a single white discal area, extending from cell R_1 into cell M; wing tip narrowly yellow; macrotrichia of veins of outer medial field sparse; abdomen polished black, broad posterior borders of segments velvety black, involving distal half to third of segments; genital shield of female black.

Male.—Length, 10 to 10.5 millimeters; wing, 8 to 8.5.

Female.—Length, 16 to 17 millimeters; wing, 11 to 12.5.

Rostrum and palpi black. Antennæ black throughout, 8-segmented in both sexes; terminal segment subequal to or a little longer than penultimate. Head black, gray pruinose.

Thorax uniformly black; setæ of præscutal interspaces relatively short and inconspicuous. Halteres and legs black. Wings (Plate 1, fig. 16) strongly suffused with blackish, cell 1st A paler; in female, axillary portion of cell 2d A similarly pale; a single white discal area, extending from cell R_1 into cell M, almost reaching vein Cu behind; wing tip narrowly yellow, involving cells R_3 to R_5, inclusive; veins brown, paler in the brightened apical lunule. Numerous macrotrichia in outer radial field, in outer medial field more sparse and restricted to extreme outer portions of veins, especially on M_{1+2}. Venation: R_{1+2} subequal to or longer than R_{2+3+4}; m-cu at from two-thirds to four-fifths

[9] Loc. cit. [10] Loc. cit., pl. 10, fig. 10.

length of cell 1st M_2; distal section of Cu_1 deflected caudad, not in longitudinal alignment with basal section.

Abdomen black, basal half or more of each tergite polished nacreous, the broad posterior borders more velvety black, involving distal half to third, narrowest on posterior segments; hypopygium and genital segments in female black; cerci horn yellow, elongate, nearly straight.

Habitat.—Eastern Borneo.

Holotype, male, Pelawau berar, Sangkoelirang district, in swampy forest, May, 1937 (*Walsh*). Allotopotype, female. Paratopotypes, 1 male, 1 female.

Hexatoma (*Eriocera*) *juxta* is closely related to *H.* (*E.*) *disjuncta* sp. nov., both species running to the same place by the use of Edwards's key to the Old World species of the subgenus.[11] The present fly differs most evidently in the nature of the wing pattern, the restricted macrotrichia of the outer medial field, the much wider opaque black margins on the abdominal tergites, and the blackened genital shield of the female.

HEXATOMA (ERIOCERA) NEPALENSIS (Westwood).

Caloptera nepalensis WESTWOOD, Ann. Soc. Ent. France 4 (1835) 681.

Widely distributed in the Himalayan region, but hitherto I had seen no materials from eastern China. Males and females, Yim-Na-San, eastern Kwangtung, altitude 1,800 to 2,750 feet, June 11 to 15, 1936 (*Gressitt*).

ELEPHANTOMYIA INULTA sp. nov. Plate 1, fig. 17; Plate 3, fig. 33.

General coloration gray, præscutum with three conspicuous brown stripes; rostrum and antennæ black, the former nearly as long as body; pleura gray, variegated with darker; legs dark brown, tarsi a little paler; wings tinged with grayish, stigma scarcely darker; anterior branch of Rs nearly perpendicular at origin, gently arcuated along posterior border of stigma; branches of Rs strongly divergent, cell R_3 at margin very wide; cell 1st M_2 large; abdominal segments more or less bicolored; hypopygium light yellow.

Male.—Length, excluding rostrum, 4.5 to 5 millimeters; wing, 5.5 to 6.5; rostrum, 4 to 4.5.

Rostrum approximately as long as body (in male), black throughout. Antennæ black, scape and pedicel more or less pruinose; verticils of outer segments moderately long. Head dark gray; anterior vertex nearly three times diameter of scape.

[11] Loc. cit.

Pronotum gray. Mesonotal præscutum gray with three conspicuous brown stripes; scutal lobes dark brown, median area pale; scutellum broad, dark brown; mediotergite paler brown. Pleura gray, variegated with dark brown on anepisternum and ventral sternopleurite. Halteres pale, knobs very weakly darkened to obscure yellow. Legs with coxæ dark; trochanters brownish black; remainder of legs dark brown, tarsi paling to obscure yellow. Wings (Plate 1, fig. 17) tinged with grayish, stigma scarcely darker; veins pale brown. Sparse trichia on anterior branch of Rs, much more abundant on vein R_5 and all outer branches of M. Venation: Sc_1 ending opposite fork of Rs, Sc_2 at tip; Rs in alignment with basal section of R_5; anterior branch of Rs very strongly arcuated to nearly perpendicular at origin, thus running relatively close to vein R_1, as in *Elephantomyodes,* but arcuated along posterior border of stigma; branches of Rs widely divergent, cell R_3 at margin thus very wide; vein M at origin arched cephalad, greatly narrowing cell R above it; cell 1st M_2 large, rectangular, nearly as long as vein M_{1+2} beyond it; m-cu at near one-fourth length of cell, a little shorter than distal section of Cu_1; cell 2d A wide.

Abdomen short, bicolored, dark brown, caudal margins of intermediate segments pale, of sternites much more broadly so; subterminal segments dark brown; hypopygium pale yellow. One paratype shows the abdominal segments much more unicolorous, tergites brown, sternites a trifle paler. Male hypopygium (Plate 3, fig. 33) with outer dististyle, *od,* bidentate at apex, distal fourth with microscopic spines. Inner dististyle, *id,* longer, entirely pale, gradually narrowed to blunt tip. What appears to represent the lateral arms of the tergite are flattened elongate pale blades, their tips obtuse, contiguous or decussate on median line with the mate of opposite side. Phallosome very pale, relatively short, lateral pale apophyses straight; ædeagus not a coiled penefilum as in typical *Elephantomyia.*

Habitat.—Assam (Khasi Hills).

Holotype, male, Cherrapunji, altitude 4,000 feet, May, 1936 (*Sircar*). Paratopotypes, 3 males.

The only other Oriental *Elephantomyia,* s. s., is *Elephantomyia* (*Elephantomyia*) *pendleburyi* Edwards (Malay Peninsula, Borneo), an entirely different fly. The venation of the radial field of the present insect much suggests the subgenus *Elephantomyodes,* but I prefer to consider the insect a true *Elephantomyia* though aberrant.

ERIOPTERINI

CLYDONODOZUS XANTHOPTERA sp. nov. Plate 1, fig. 18.

Mesonotal præscutum and scutum brownish yellow, darker laterally; head grayish white; scutellum brownish black to black; pleura black, heavily dusted with silvery; halteres yellow; legs yellow, femora with a blackened subterminal ring; wings yellow, with a restricted dark-brown pattern; R_{2+3+4} preserved as a short element; abdomen yellow, with a narrow lateral black stripe.

Male.—Length, about 13 millimeters; wing, 10.

Female.—Length, about 14 to 15 millimeters; wing, 11 to 11.5.

Rostrum dark brown; palpi 4-segmented, outer two segments shortest, crowded; basal segments brownish yellow, outer two segments black. Antennæ with scape brown, very sparsely pruinose; pedicel yellow, flagellum brownish black; flagellar segments cylindrical, with long conspicuous verticils that much exceed segments in length. Head heavily dusted with grayish white, most conspicuous on wide anterior vertex; postgenæ less heavily dusted.

Mesonotal præscutum and scutum brownish yellow, polished, central portion paler; a small black lateral spot behind transverse suture; scutellum brownish black to black, parascutella pale; mediotergite brown. Pleura black, very heavily dusted with silvery. Halteres yellow, stem a little more obscurely so than knob. Legs with coxæ black basally, pruinose, apices paling to brownish yellow; trochanters obscure yellow; femora yellow, with a conspicuous brownish black ring immediately before apex; tibiæ and basal four tarsal segments uniformly pale yellow, terminal segment darkened. Wings (Plate 1, fig. 18) strongly suffused with yellow, costal region more saturated; small dark-brown spots and seams as follows: Interrupted series along cord and outer end of cell 1st M_2; arculus; origin of Rs; Sc_2; tip of vein R_3; fork of M_{1+2}; paler marginal clouds at ends of veins M_1, M_2, and M_3; a paler brown longitudinal wash in cell 1st A at near midlength of vein; veins yellow, dark brown in infuscated portions. Venation: Cell C wide, especially in male; Rs angulated and short-spurred at origin; R_3 in longitudinal alignment with Rs, leaving a short element representing R_{2+3+4}; vein R_4 decurved at apex; cell 1st M_2 relatively small; cell M_1 subequal in length to its petiole.

Abdomen yellow, with a narrow lateral black stripe; hypopygium yellow.

Habitat.—Eastern Borneo.

Holotype, male, Batanbessi, Sangkoelirang district, in swampy forest, May, 1937 (*Walsh*). Allotype, female, Pelawau berar, Sangkoelirang district, May, 1937. Paratopotype, 1 female.

From the species of *Clydonodozus* hitherto made known from the East Indian islands, including *C. curvinervis* Edwards (North Borneo), *C. griseiceps* de Meijere (Simalur), *C. multistriatus* Enderlein (Sumatra), and *C. punctulatus* Edwards (Sumatra), the present fly differs in the combination of characters as diagnosed above, notably the coloration of antennæ, head, mesonotum, and legs. It is apparently closest to *curvinervis,* differing in the coloration of the head, legs, halteres, wings, and abdomen.

LIPSOTHRIX ASSAMICA sp. nov. Plate 1, fig. 19.

Thorax entirely pale yellow, unmarked; antennæ (male) relatively long, if bent backward extending about to the wing root; halteres yellow throughout; wings subhyaline, prearcular and costal regions clear light yellow; complete series of macrotrichia on all longitudinal veins beyond cord; R_{2+3+4} and anterior branch of Rs subequal; basal section of R_5 angulated and weakly spurred at near midlength; cell M_2 open by atrophy of m; cell M_3 about twice its petiole; m-cu at fork of M; cell 2d A relatively wide; abdominal tergites brownish black, caudal and lateral margins of segments yellow; basal sternites clear light yellow, outer segments uniformly blackened.

Male.—Length, about 5.5 millimeters; wing, 6.3.

Rostrum obscure yellow; palp brownish black. Antennæ (male) relatively long, if bent backwards extending to wing root; scape and pedicel yellow; basal segment of flagellum brownish yellow, succeeding segments black; flagellar segments subcylindrical, with an abundant white pubescence; verticils sparse, shorter than segments. Head yellow.

Mesonotum and pleura entirely pale yellow, unmarked. Halteres yellow throughout, stem relatively slender. Legs with coxæ and trochanters pale yellow; remainder of legs broken. Wings (Plate 1, fig. 19) subhyaline, prearcular and costal region clear light yellow; stigmal area scarcely darkened and entirely undelimited; veins brown, those in the yellow areas luteous. Costal fringe short; complete series of macrotrichia on all longitudinal veins beyond cord. Venation: Sc_1 ending shortly before fork of Rs, Sc_2 at its tip; Rs relatively long, about one-third longer than R_{2+3+4}; R_{1+2} and R_2 subequal, both very pale to nearly evanescent, former about twice as long as R_{2+3}; R_{2+3+4} unusually

long, subequal to entire anterior branch of Rs; basal section of R_5 angulated and weakly spurred at near midlength; cell M_2 open by atrophy of m; cell M_3 about twice its petiole; m-cu at fork of M; cell 2d A relatively wide.

Abdominal tergites brownish black, caudal and lateral margins of intermediate segments yellow, the amount increasing on segments five and six; outer segments uniformly blackened; basal sternites clear light yellow; hypopygium brownish yellow.

Habitat.—Assam (Khasi Hills).

Holotype, male, Cherrapunji, altitude 4,000 feet, May, 1936 (*Sircar*).

Lipsothrix assamica is readily told from all described Asiatic species by the venation, especially the subequal R_{2+3+4} and anterior branch of Rs, and by the open cell M_2.

TRENTEPOHLIA (PLESIOMONGOMA) CALLINOTA sp. nov. Plate 1, fig. 20.

Mesonotal præscutum yellow, color almost obliterated by blackened areas; median præscutal stripe with central portion of anterior half more reddish brown; flagellar segments long-cylindrical, about four times as long as thick; all tibiæ white, with a slightly indicated dark ring on basal third; wings whitish subhyaline, prearcular and costal portions clearer yellow, including veins; wing tip infuscated.

Female.—Length, about 11 millimeters; wing, 6.5.

Rostrum and palpi black. Antennæ with scape and pedicel brownish black, a little paler beneath; basal three or four flagellar segments brown, remainder black; antennæ relatively long, flagellar segments cylindrical, approximately four times as long as thick; terminal segment about one and one-fourth length of penultimate. Head behind yellow, with a paler median carina that is a caudal elongation of the narrow anterior vertex.

Cervical region dark brown. Pronotum brownish black. Mesonotal præscutum with the restricted ground color yellow, surface almost covered by dark; median stripe brownish black, central portion on anterior half paling to reddish brown; entire lateral margin of præscutum broadly polished black, including humeral region, as well as widened posterior portions, crossing suture and including scutal lobes; median area of scutum yellow; scutellum infuscated, restrictedly pale on caudal border; mediotergite black. Pleura and pleurotergite light yellow, ventral sternopleurite darkened. Halteres brownish black, extreme base of stem pale. Legs with all coxæ and trochanters pale yellow; femora yellow basally, deepening to brown outwardly,

tips abruptly and rather broadly (about 1 millimeter) snowy white; tibiæ white, slightly infuscated just beyond base, the amount including about one-third to one-fourth total length of segment; tarsi white, outer segments a trifle darkened; femora and tibiæ without spines but with scattered long black setæ. Wings (Plate 1, fig. 20) narrow; whitish subhyaline, prearcular and costal regions clearer yellow; stigma small, dark brown; wing tip conspicuously infuscated; scarcely evident darkenings at origin of Rs and on m-cu; veins dark brown, yellow in luteous areas. Venation: Sc_1 ending shortly before R_2, latter subequal to R_{1+2}.

Abdominal tergites brownish black, paler laterally; sternites paler brown, subterminal sternite black; genital segment obscure yellow.

Habitat.—Eastern Borneo.

Holotype, female, Pelawau berar, Sangkoelirang district, in swampy forest, May, 1937 (*Walsh*).

Trentepohlia (*Plesiomongoma*) *callinota* is most similar to *T.* (*P.*) *candidipes* Edwards, of the Malay Peninsula, differing especially in the coloration of the thorax, legs, and wings, and in the structure of the antennæ.

GONOMYIA (LIPOPHLEPS) PHORACANTHA sp. nov. Plate 1, fig. 21; Plate 3, fig. 34.

Belongs to the *nubeculosa* group, allied to *pallidisignata;* general coloration plumbeous black; scutellum yellow, with a darkened median spot at base; pleura with a narrow pale longitudinal stripe; femoral rings broad, black; wings infumed, variegated with white; cell R_1 relatively wide; male hypopygium with inner dististyle bearing a slender spine at base; phallosome consisting of two simple curved spines arising from complex basal rods and plates.

Male.—Length, about 3 millimeters; wing, 3.2.

Rostrum and palpi black. Antennæ with basal segments yellow above, darker beneath; flagellum black, with very long verticils. Head yellow, center of vertex darkened.

Lateral pretergites narrowly pale yellow. Mesonotal præscutum and scutum plumbeous black; scutellum bright yellow, base darkened on median portion, parascutella black; mediotergite plumbeous black. Pleura almost uniformly plumbeous black, with a narrow and ill-defined whitish longitudinal stripe extending from and including fore coxæ, reaching base of abdomen. Halteres yellow, knobs darkened basally above. Legs with fore and hind coxæ pale, midcoxæ black with the apices restrictedly

pale; trochanters yellow; femora brownish yellow with a broad black subterminal ring, preceded and followed by much narrower, clearer yellow rings; tibiæ and tarsi obscure yellow, outer tarsal segments more darkened; claws simple. Wings (Plate 1, fig. 21) strongly suffused with brown, prearcular field, broad costal border, wing tip, and distal ends of outer medial and cubital cells white; a small darker brown spot at tip of Sc and origin of Rs; stigma brown, a trifle darker than ground color; veins brown, whitened in ground color. Venation: Sc_1 ending immediately beyond origin of Rs, Sc_2 at its tip; Rs and R_{2+3+4} somewhat distant from R_1, so cell R_1 is relatively wide; vein R_3 nearly perpendicular; cell R_2 at margin more extensive than cell R_3; m-cu at fork of M.

Abdomen black, caudal borders of outer tergites pale; hypopygium dark. Male hypopygium (Plate 3, fig. 34) with outer dististyle, *od*, a simple darkened, gently curved rod, with a weak flange on mesal face of basal half. Inner dististyle, *id*, pale, with a conspicuous pale spine at base, this spine about one-fourth length of outer dististyle. Phallosome, *p*, consisting of two slender simple curved spines about one-half length of outer dististyle, arising from a complex series of blackened rods and plates, as illustrated.

Habitat.—Eastern Borneo.

Holotype, male, Pelawau berar, Sangkoelirang district, in swampy forest, May, 1937 (*Walsh*).

The nearest ally of the present fly is *Gonomyia* (*Lipophleps*) *pallidisignata* Alexander (Luzon), which has the hypopygium somewhat similar in construction, the inner dististyle having a conspicuous basal spine forming an apparent additional or intermediate dististyle. The present fly differs from *pallidisignata* in the details of coloration but especially in the phallosome, the outer rods consisting of straight, daggerlike points from an inconspicuous sclerotized basal scaffolding. *G.* (*L.*) *nubeculosa* de Meijere is again quite distinct, the inner dististyle being unarmed and the phallosome again different, the outer rods being long and powerful, subequal in length and size to the outer dististyle.

STYRINGOMYIA REDUCTA sp. nov. Plate 1, fig. 22; Plate 3, fig. 35.

General coloration black, including halteres and legs; setæ of head and mesonotum relatively small and weak; wings with a strong blackish tinge; anterior branch of Rs oblique, unusually long, nearly one-half as long as Rs alone; m-cu a trifle more

than its own length beyond fork of M; vein 2d A simple; male hypopygium without spines on basistyle; dististyle complex, outer arm unusually reduced in size; ædeagus with distal end resembling head of a sea horse.

Male.—Length, about 6 millimeters; wing, 5.2.

Rostrum and palpi black. Antennæ with the scape and pedicel obscure yellow beneath, remainder of organ black. Head obscure yellow, variegated with brown, including a large area in center of posterior vertex; setæ inconspicuous.

Pronotum very pale yellow, darkened in the depressed central portion. Lateral pretergites pale yellow. Mesonotal præscutum black, surface dull, sparsely pruinose; restricted humeral region orange-yellow; setæ relatively small and inconspicuous; posterior sclerites of notum dark, central portion of scutellum and lateral portions of mediotergite a little paler; scutellum with erect setæ. Pleura dull black. Halteres and legs black throughout. Wings (Plate 1, fig. 22) with a strong blackish tinge, base vaguely paler; veins dark brown. Costal fringe of moderate length. Venation: Anterior branch of Rs oblique, unusually long, nearly one-half as long as Rs alone; cell 2d M_2 barely sessile; m-cu a trifle more than its own length beyond fork of M; vein 2d A long and simple.

Abdomen, including hypopygium, black throughout; segments with abundant dense erect setæ. Male hypopygium (Plate 3, fig. 35) without spines on basistyle, *b*. Dististyle with the outer arm, *od*, unusually reduced, only about one-half as long as longest lobe of intermediate style, very slender, setæ correspondingly small and weak; intermedite arm, *md*, long, stout, cylindrical, with numerous coarse setæ, at base with a blackened mushroom-shaped lobe; inner arm, *id*, elongate, pale, gradually narrowed to a short blackened point, surface with abundant long delicate setæ; at base of style a cylindrical blackened lobe. A further appendage, apparently of the dististyle, appears as a strongly curved dark arm superimposed against basistyle. Ædeagus, *a*, resembling head of a sea horse, *Hippocampus*, crown with two small black spines, surface with abundant setæ.

Habitat.—Mindanao.

Holotype, male, Mount Apo, Galog River, altitude 6,000 feet, October 1, 1930 (*Clagg*).

Styringomyia reducta is entirely distinct from the other described black species of the genus that have the legs and halteres

uniformly black. The male hypopygium shows very distinct structural features.

STYRINGOMYIA GEMINATA sp. nov. Plate 1, fig. 23; Plate 3, fig. 36.

General coloration of notum brownish yellow, variegated with brown; antennal flagellum black throughout; knobs of halteres yellow; legs yellow, ringed with brown, rings complete and well-defined; wings yellow with many of the veins black; anterior branch of Rs relatively short, oblique; abdominal tergites bicolored, yellow, caudal margins dark brown; male hypopygium with basistyle terminating in two slender spinous setæ that arise from a single low tubercle; sternite narrow, two setæ placed close together at apex.

Male.—Length, about 8.5 millimeters; wing, 5.2.

Female.—Length, about 6 millimeters; wing, 4.5.

Rostrum pale; palpi black. Antennæ with scape yellow above, blackened beneath; remainder of organ black; flagellar segments cylindrical, with conspicuous verticils. Head chiefly ochreous, with conspicuous setæ, some modified.

Mesonotal præscutum brownish yellow, with dark markings especially on posterior half; scutal lobes yellow, their posterior margins brown; scutellum yellow, bordered posteriorly by black; mediotergite black, paler laterally; mesonotum with some erect modified setæ. Pleura variegated yellow and black, pale yellow ventrally. Halteres with knob and base of stem yellow, remainder of stem darkened. Legs with coxæ and trochanters pale yellow; remainder of legs yellow, conspicuously ringed with brown, as common in the genus, rings complete and well-delimited. Wings (Plate 1, fig. 23) with a strong yellow tinge; veins yellow, following veins black: Anterior branch of Rs; r-m; M and its outer branches; m-cu; tips of veins R_5 to 2d A, inclusive, on last-named vein including about distal half; a distinct cloud surrounding r-m. Costal fringe erect, conspicuous. Venation: Anterior branch of Rs relatively short, oblique; cell 2d M_2 barely sessile.

Abdominal tergites bicolored, segments yellow, conspicuously ringed caudally with dark brown, central portion of basal ring very faintly suffused with dusky; sternites yellow, caudal margins of segments faintly darkened. Male hypopygium (Plate 3, fig. 36) with apex of basistyle, *b*, bearing a low tubercle that terminates in two long slender black setæ. Dististyle, *d*, with outer arm, *od*, uniformly blackened, with weak setæ. Tergite,

t, with apical lobe broadly and evenly rounded, densely setulose. Sternite, *s*, narrow, with two long apical setæ, these placed less than their own width apart.

Habitat.—Eastern Borneo.

Holotype, male, Pelawau berar, Sangkoelirang district, in swampy forest, May, 1937 (*Walsh*). Allotopotype, female.

From the other members of the genus *Styringomyia* having bispinous basistyles, including *S. acuta* Edwards, *S. armata* Edwards, *S. claggi* Alexander, *S. curvispina* Edwards, *S. ensifera* Edwards, *S. holomelania* Alexander, *S. spathulata* Alexander, and probably *S. transversa* Edwards, the present fly is readily told by the structure of the male hypopygium, especially the location of both spines on a common tubercle. The other species, with the exception of the entirely distinct *holomelania,* have these spines arising from individual tubercles and further have the details of the dististyle quite distinct.

STYRINGOMYIA ANGUSTITERGATA sp. nov. Plate 1, fig. 24; Plate 3, fig. 37.

General coloration yellow, variegated with brown; antennal flagellum yellow; dark rings on legs incomplete; wings yellow, with a restricted dark pattern; vein 2d A simple, its distal fourth blackened; male hypopygium with spine of basistyle single, flattened, shorter than its long basal tubercle; tergite with terminal lobe long and narrow, with a dense clothing of long erect setæ; sternite terminating in two short blackened points, separated by a U-shaped median notch, modified setæ subapical.

Male.—Length, about 7 millimeters; wing, 5.

Female.—Length, about 6 millimeters; wing, 4.6.

Rostrum yellow; palpi bicolored, ringed yellow and brown. Antennæ with scape yellow, especially above; pedicel pale brown; flagellum yellow. Head yellow; bristles proclinate, moderately stout.

Pronotum yellow medially, darkened on sides. Mesonotal præscutum chiefly yellow, anterior third a little more darkened, posterior portion nearly clear, median stripe delimited only in front, becoming obsolete behind; lateral stripes reduced to small dark spots at suture; scutum yellow, each lobe with two small isolated brown areas; scutellum yellow, with two erect setæ; mediotergite weakly darkened. Pleura pale yellow. Halteres yellow. Legs with coxæ and trochanters yellow; remainder of legs pale yellow with the usual dark rings on femora and tibiæ, these narrow and interrupted on lower faces of segments; tips of tibiæ and individual tarsal segments darkened. Wings (Plate

1, fig. 24) pale yellow, with a restricted dark pattern on veins, as follows: r-m, involving the adjoining portion of membrane; m-cu; outer end of cell 1st M_2; distal fourth of vein 2d A; veins very pale yellow, darkened as described. Venation: Anterior branch of Rs oblique; r-m just beyond fork of Rs, basal section of R_5 short to virtually lacking; cell 2d M_2 very short-petiolate to virtually sessile; m-cu close to midlength of cell 1st M_2; vein 2d A simple but with tip bent strongly into margin.

Abdominal tergites yellow with small paired dark spots before midlength and with caudal border insensibly darkened; on subterminal segments the brown more extensive to form a continuous median vitta; in the female the pattern heavier, consisting of two pairs of dark spots as described; sternites more uniformly yellow. Male hypopygium (Plate 3, fig. 37) with the spine of basistyle, *b,* single, relatively short and flattened, arising from a long basal tubercle that exceeds it in length. Dististyle, with outer arm, *od,* long, outer margin darkened; remainder of dististyle as figured, intermediate arm, *md,* produced into a long spine, inner arm with two shorter stout blackened points. Tergite, *t,* with terminal lobe unusually long and narrow, its length many times its greatest width, surface squamose, with abundant erect setæ, all exceeding width of blade. Sternite, *s,* depressed, apex with two short blackened points, separated by a small U-shaped notch, usual paired setæ placed subapically.

Habitat.—Philippine Islands.

Holotype, male, Calanag; in the Museum of Comparative Zoölogy, Cambridge, Massachusetts, through Dr. Nathan Banks. Allotopotype, female. Paratopotype, female.

Styringomyia angustitergata is quite distinct from all known species of the genus. The structure of the male hypopygium, especially of the tergite and sternite, readily separates the fly from all described allies.

ILLUSTRATIONS

[*a*, Ædeagus; *b*, basistyle; *d*, dististyle; *dd*, dorsal dististyle; *g*, gonapophysis; *id*, inner dististyle; *md*, intermediate lobe of dististyle; *od*, outer dististyle; *p*, phallosome; *s*, sternite; *t*, tergite; *vd*, ventral dististyle.]

PLATE 1

FIG. 1. *Eutanyderus oreonympha* sp. nov., venation.
2. *Dolichopeza* (*Oropeza*) *fokiensis* sp. nov., venation.
3. *Tipula* (*Schummelia*) *bicolorata* sp. nov., venation.
4. *Limonia* (*Libnotes*) *citrivena* sp. nov., venation.
5. *Limonia* (*Geranomyia*) *torta* sp. nov., venation.
6. *Helius* (*Helius*) *pavoninus* sp. nov., venation.
7. *Helius* (*Helius*) *ctenonycha* sp. nov., venation.
8. *Helius* (*Helius*) *nigricapella* sp. nov., venation.
9. *Gynoplistia* (*Gynoplistia*) *albizonata* sp. nov., venation.
10. *Hexatoma* (*Eriocera*) *perornata* sp. nov., venation.
11. *Hexatoma* (*Eriocera*) *perlunata* sp. nov., venation.
12. *Hexatoma* (*Eriocera*) *nimbipennis* sp. nov., venation.
13. *Hexatoma* (*Eriocera*) *enavata* sp. nov., venation.
14. *Hexatoma* (*Eriocera*) *azurea* sp. nov., venation.
15. *Hexatoma* (*Eriocera*) *disjuncta* sp. nov., venation.
16. *Hexatoma* (*Eriocera*) *juxta* sp. nov., venation.
17. *Elephantomyia inulta* sp. nov., venation.
18. *Clydonodozus xanthoptera* sp. nov., venation.
19. *Lipsothrix assamica* sp. nov., venation.
20. *Trentepohlia* (*Plesiomongoma*) *callinota* sp. nov., venation.
21. *Gonomyia* (*Lipophleps*) *phoracantha* sp. nov., venation.
22. *Styringomyia reducta* sp. nov., venation.
23. *Styringomyia geminata* sp. nov., venation.
24. *Styringomyia angustitergata* sp. nov., venation.

PLATE 2

FIG. 25. *Dolichopeza* (*Oropeza*) *fokiensis* sp. nov., male hypopygium.
26. *Tipula* (*Schummelia*) *bicolorata* sp. nov., male hypopygium, lateral aspect.
27. *Tipula* (*Schummelia*) *bicolorata* sp. nov., male hypopygium, tergite.
28. *Limonia* (*Libnotes*) *citrivena* sp. nov., male hypopygium.
29. *Limonia* (*Geranomyia*) *torta* sp. nov., male hypopygium.
30. *Helius* (*Helius*) *pavoninus* sp. nov., male hypopygium.
31. *Helius* (*Helius*) *ctenonycha* sp. nov., male hypopygium.
32. *Helius* (*Helius*) *nigricapella* sp. nov., male hypopygium.

PLATE 3

FIG. 33. *Elephantomyia inulta* sp. nov., male hypopygium.
34. *Gonomyia* (*Lipophleps*) *phoracantha* sp. nov., male hypopygium.
35. *Styringomyia reducta* sp. nov., male hypopygium.
36. *Styringomyia geminata* sp. nov., male hypopygium.
37. *Styringomyia angustitergata* sp. nov., male hypopygium.

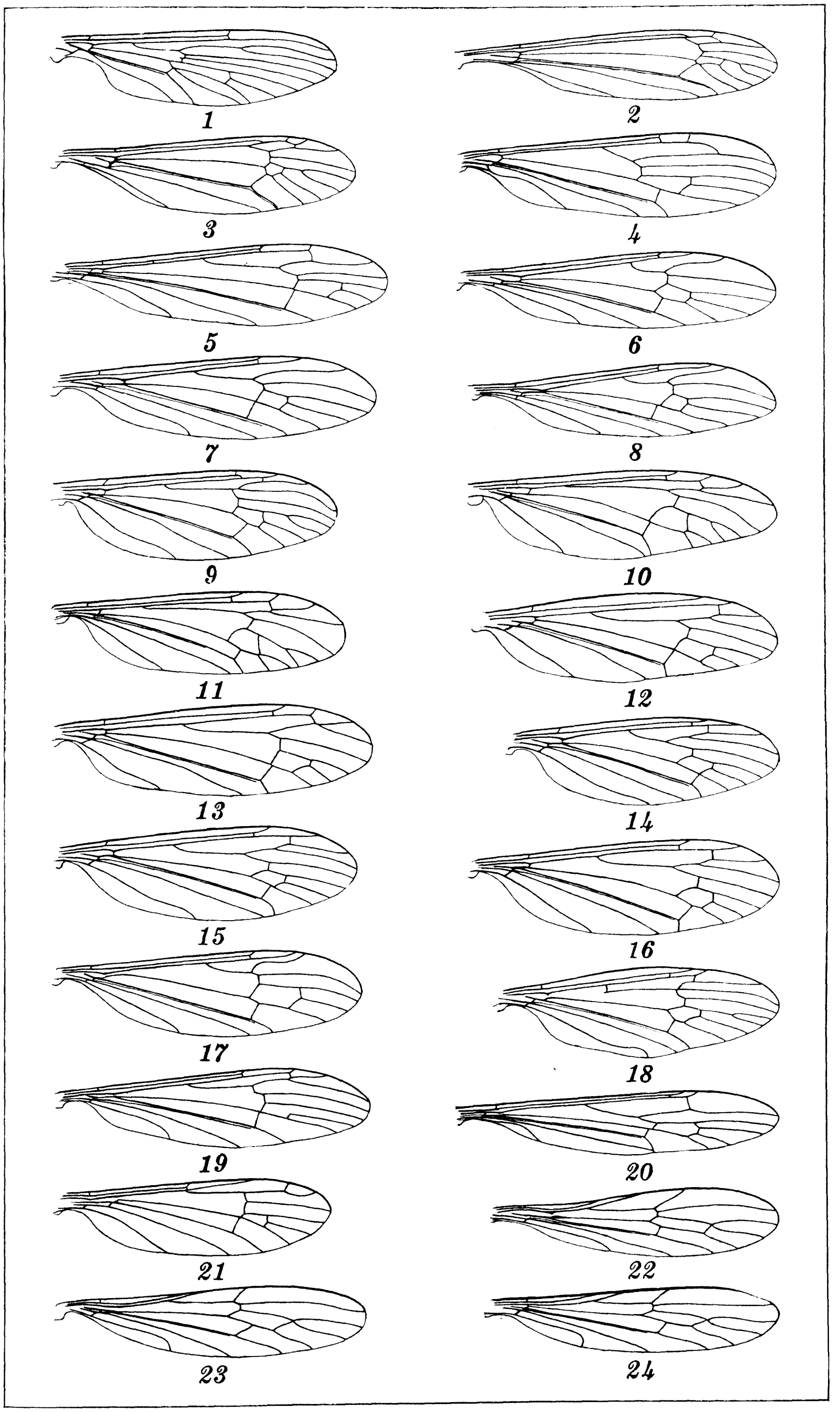

PLATE 1.

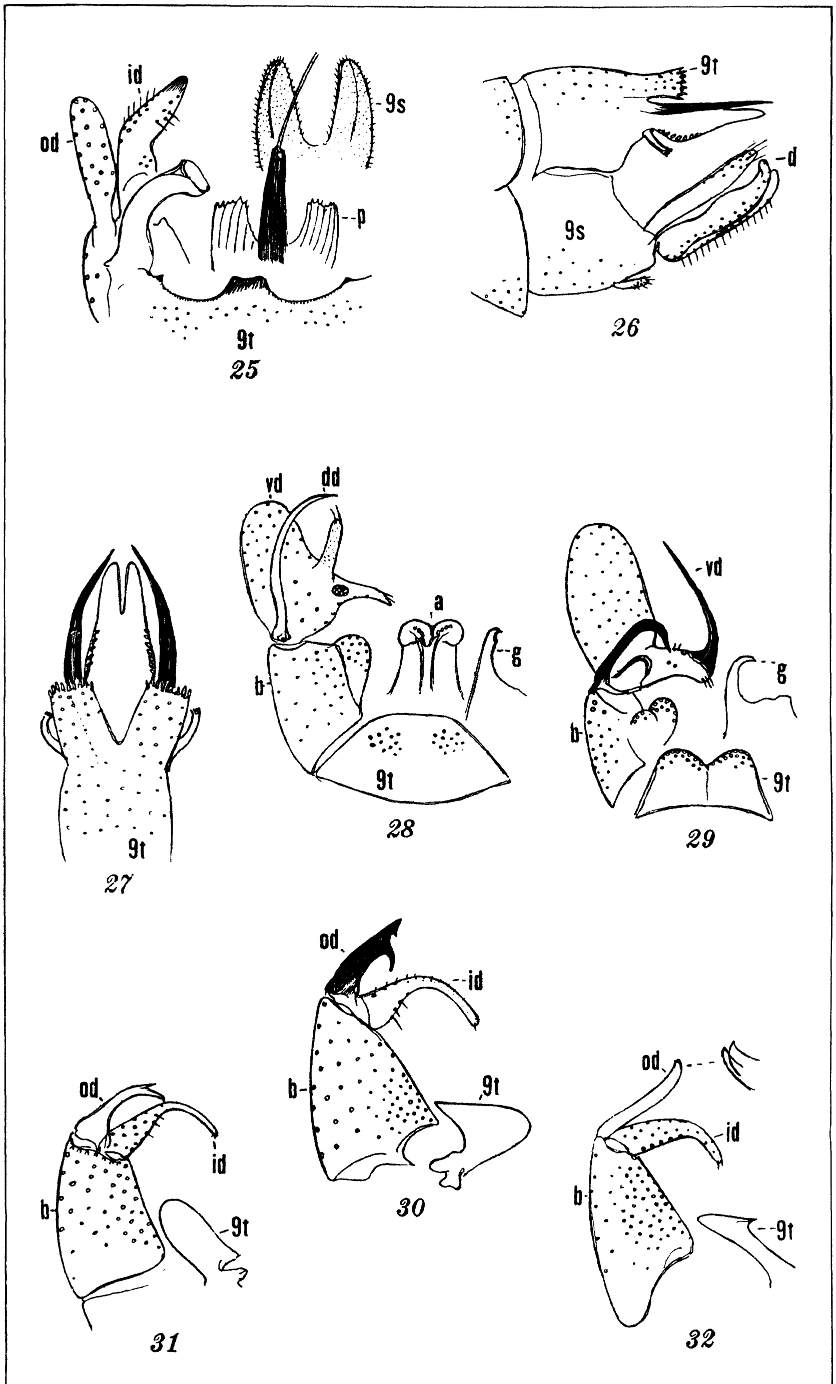

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PLATE 2.

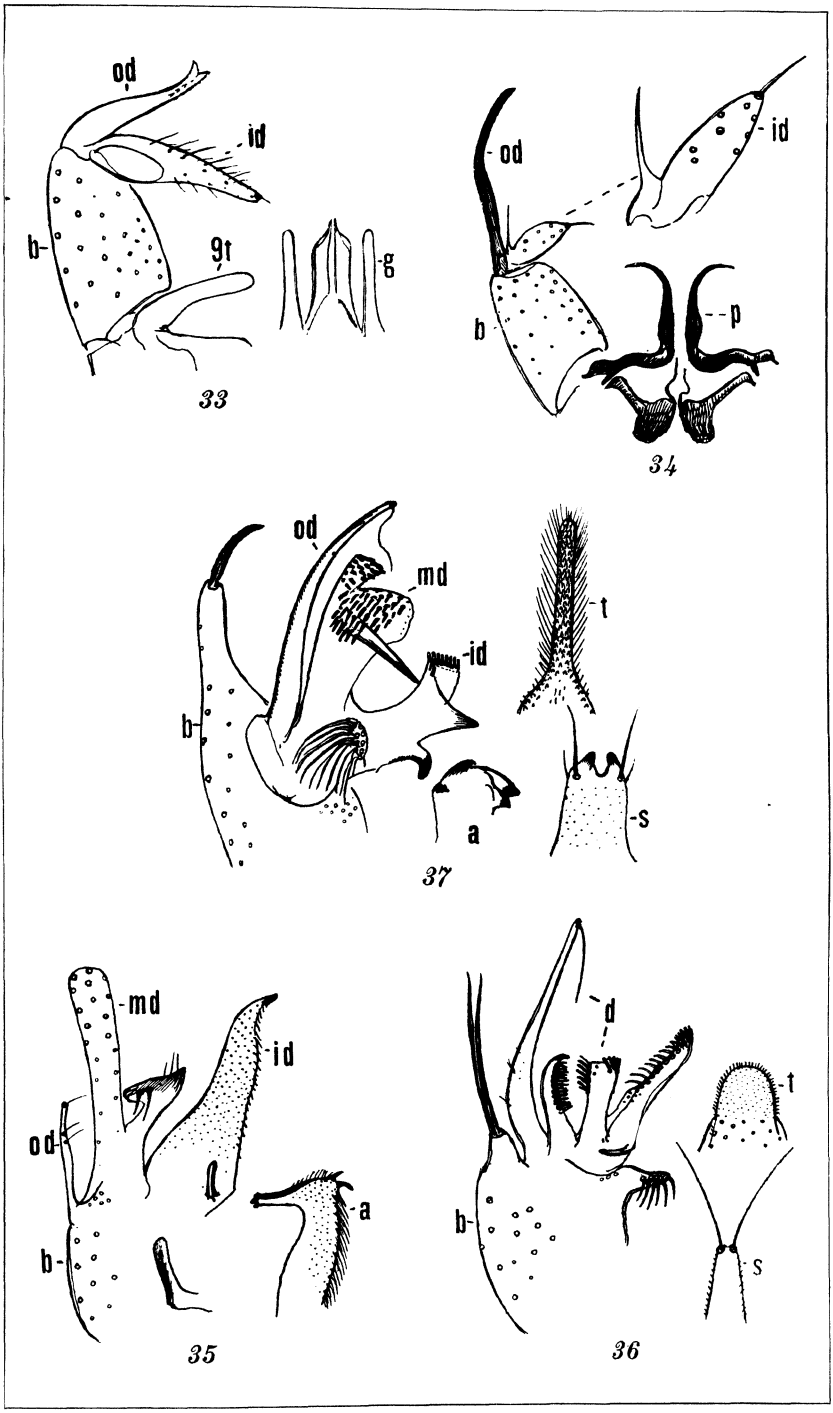

PLATE 3.

A NEW TÆNIOID FISH FROM OCCIDENTAL NEGROS

By HILARIO A. ROXAS and GUILLERMO L. ABLAN
Of the Fish and Game Administration, Bureau of Science, Manila

TWO PLATES

The genus *Leme*, created by de Vis in 1833 with *Leme mordax* as type, was differentiated from the genus *Tænioides* Lacépède "in having prominent ridges of papillæ on the head." Koumans, in his revision of the genera of gobioid fishes (1931) compared the type of the genus *Tænioides* (*T. hermannianus*), which he actually saw, with the figures of *Leme purpurascens* de Vis and *Leme mordax* de Vis, as pictured by McCulloch and Ogilby (1919). He found the ridges of papillæ as having the same locations and extent in the three species. It seems, therefore, safe to assume that the genus *Leme* de Vis is a synonym of *Tænioides* Lacépède. This genus is close to *Gobioides* Lacépède (1800) from which it differs in having barbels but no scales and having a greater number of rays in the vertical fins. *Tænioides* also differs from *Nudagobioides* Shaw (1929) in having barbels on the chin, in having smaller pectorals and caudals, and in not having externally visible myotomes.

TÆNIOIDES CANISCAPULUS sp. nov.

Head 8.2; depth 13; dorsal VI–42; anal 41.

Body stout, the anterior portion subcylindrical, the posterior laterally compressed; greatest depth at ventral slit to dorsal fin; pores in series present along lateral side of body.

Head blunt, width slightly less than depth, ridges of papillæ raised. Profile from chin to lower jaw bulldoglike. Mouth wide, subvertical, 2 in head; lips thick, fleshy, expanded into broad pads and very much enlarged at angles of mouth, especially the upper ones, with more prominent sensory papillæ. Teeth of upper jaw in five series; those of outer (exposed) rows of subulate teeth the first with 3 incurved teeth on tip of snout, the middle tooth smaller and shorter than the outer two; under or behind the first 14 teeth widely separate, teeth of inner series villiform, closely set, short, pointed. Teeth in the lower jaw in five rows; the outermost row composed of 9 prominent in-

curved teeth; the inner rows of small and pointed teeth; teeth absent on lower terminals of lower jaw. Chin distinctly and obtusely arched, with 3 pairs of short coarse barbels below symphysis; a single barbel present between the middle pair; above the chin a groove. Branchiostegals 5; gill opening as wide as caudal; gillrakers 10, short and tuberclelike; a series of 13 sensory papillæ present from a little above the origin of the fifth branchiostegal to the first barbel, other sensory papillæ also present behind upper jaw; eyes concealed.

Dorsal and anal densely enveloped in a very thick, tough skin, continuous with caudal. Origin of dorsal very far advanced of ventral, with length 1.2; anal higher than dorsal, with length 1.6; its junction with the caudal marked by a deep and conspicuous notch. Pectorals short, small and rounded, 3 in head. Ventrals broad and long, width less than one-half length. Caudal lanceolate, with length equal to head.

Color in life yellowish, in spirit body ash gray, dorsal and anal grayish.

The presence of an extra series of teeth at the tip of the snout and semiserrated anal margin distinctly characterizes the present species from any other species of the genus.

Here described from type specimen No. 41349, 256.5 millimeters long, the only specimen obtained from a burrow by the side of the dike of the Government Experimental Fish Farm, Hinigaran, Occidental Negros, Philippine Islands, November 15, 1936, by the junior author. The specimen is kept in the ichthyological collection of the Fish and Game Administration of the Bureau of Science, Manila.

Caniscapulus, dog-head.

Measurements.—Total length, 256.5 millimeters; standard length, 228.5; depth of body at anal origin, 17.5; length of head, 28; width of head, 19; depth of head, chin to dorsal side, 20; width of mouth, 14; width of gill opening, 11; length of pectoral, 9; width of pectoral, 6.5; length of ventral, 22; width of ventral at second ray, 13; length of caudal, 28; width of caudal, 11; height of caudal base, 8; length of dorsal, 190; height of dorsal, 5.5; length of anal, 140; height of anal, 7; snout to origin of dorsal, 47; snout to origin of anal, 82; pectoral base to tip of ventral, 27; ventral tip to first anal ray, 27; lower jaw to chin, 19.5; chin to base of ventral, 25.

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LACÉPÈDE, A. Hist. Nat. Poiss. 2 (1798) 580; 4 (1800) 339–397.

ILLUSTRATIONS

[Plate 1 was drawn by Pio Medel.]

PLATE 1

Tænioides caniscapulus sp. nov.; from type.

PLATE 2

FIG. 1. Side view of *Tænioides caniscapulus* sp. nov., from preserved type specimen.

2. Ventral view of head and trunk of *Tænioides caniscapulus* sp. nov.

3. Side view of head and trunk of *Tænioides caniscapulus* sp. nov.

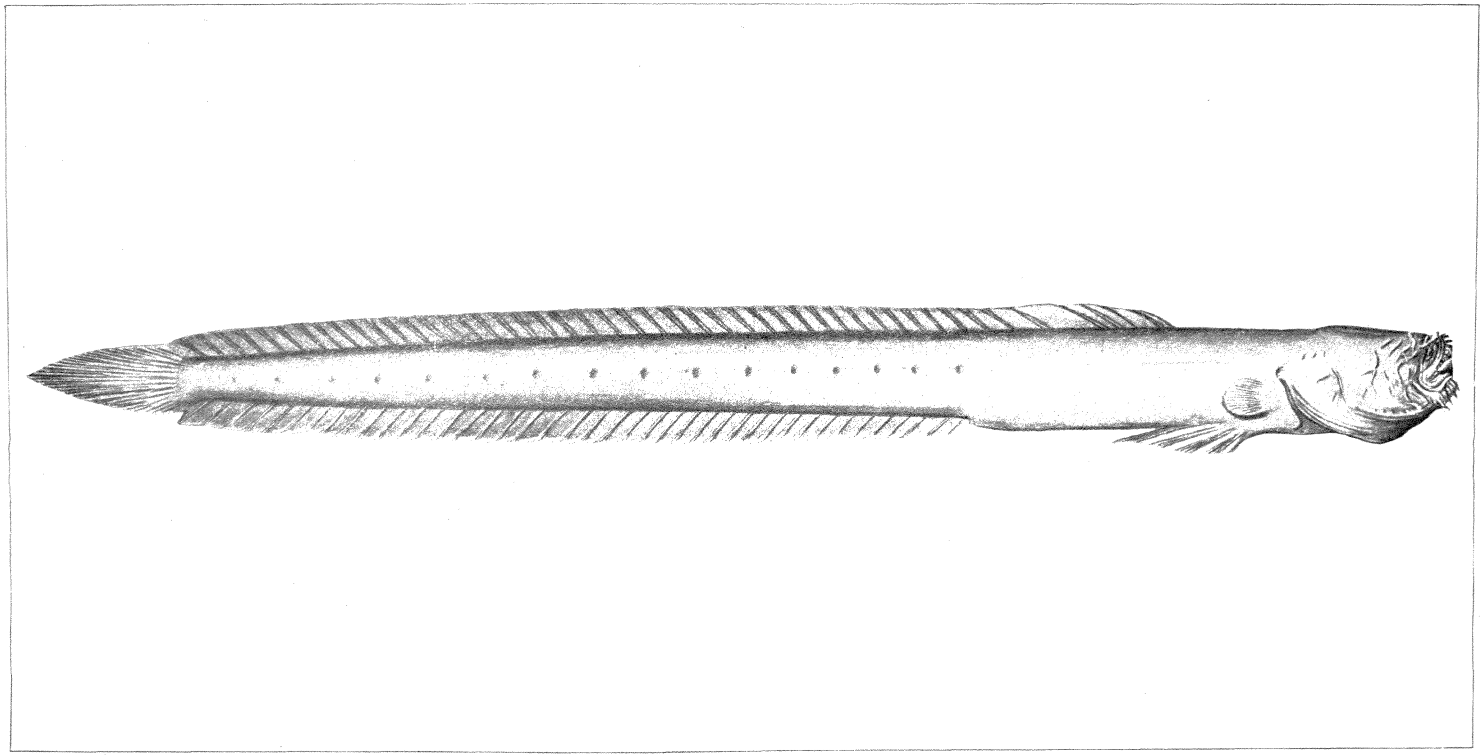

PLATE 1. TÆNIOIDES CANISCAPULUS SP. NOV., FROM TYPE.

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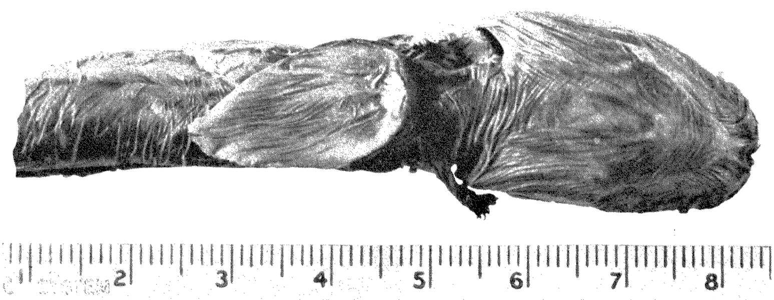

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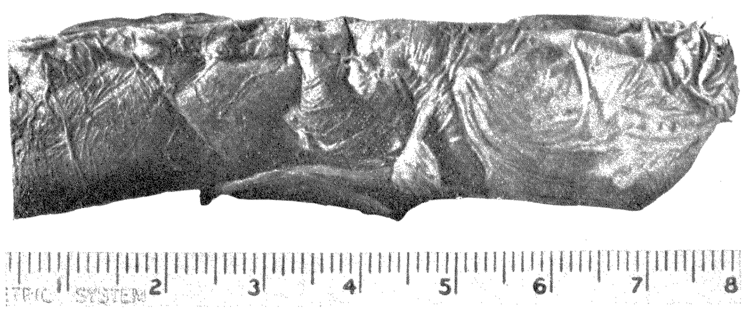

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PLATE 2. TÆNIOIDES CANISCAPULUS SP. NOV.

THE AVIFAUNA OF THE GIGANTE ISLANDS

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The Gigante Islands[1] are a group of two high islands and several islets and detached rocks, about 10 miles east of Bulacaue Point, the northeastern extremity of Panay. The two high islands, North Gigante and South Gigante, are separated by a narrow channel which at some places is only ½ mile wide.

North Gigante is 758 feet high near the northern end, and wooded. Its area is about 5 square miles, only a very small portion of which is under cultivation.

South Gigante is ½ mile south of North Gigante. It is 763 feet high near the southern end, and well wooded. It is somewhat larger than North Gigante, but its area also is only a few square miles, with only a very small portion under cultivation.

North and South Gigante are very sparsely populated, and most of the inhabitants are fishermen. These fishermen bring their products to Estancia, the nearest town in the mainland, and return to the islands with food supplies, as their crops cannot be depended upon.

There are no means of communication and transportation between the mainland and the Gigante Islands, except the irregularly plying frail sailboats, privately owned by fishermen. During the stormy months, from October to January, only the more daring attempt to cross, thus it is not uncommon for the islanders to suffer from scarcity of food, when no boats carrying food supplies come from the mainland. Transportation being difficult in these parts, it is not surprising that no collector has visited them prior to our recent visit.

Sailing on the government fishing boat, M/L "Science I," Francisco S. Rivera and I were able to do some collecting and observing in these islands. We arrived in North Gigante July 13, 1937, and after 5 days of extensive observation and collecting in both islands, we sailed for the Island of Panay July 17. The present paper contains the results of the collections and observations made on this trip.

[1] U. S. Coast Pilot 1927.

The nomenclature adopted in this paper is taken from: Peters, J. L., "Birds of the World," 2 volumes; Hachisuka, M., "Birds of the Philippine Islands," 4 parts; Kuroda, N., "Birds of the Island of Java," 2 volumes; Chasen F. N., "A Handlist of Malaysian Birds;" McGregor, R. C., "A Manual of Philippine Birds."

BIRDS FROM NORTH GIGANTE

TURNIX SUSCITATOR FASCIATA (Temminck).

One male.

A specimen of the Philippine button quail with imperfect plumage was collected in short-grass tracts of the island. It is indistinguishable from typical *T. s. fasciata* from Luzon.

The native name is *pitao.*

TRERON VERNANS VERNANS (Linnæus).

Four males and one female.

Flocks of pink-necked green pigeons were common, feeding usually on the fruits of *binayoyo* (*Antidesma ghaesembilla* Gaertn.).

The native name is *punay.*

STREPTOPELIA BITORQUATA DUSSUMIERI (Temminck).

One male and four females.

Dussumier's turtle dove was abundant in the scraggy growth throughout the island.

The native name is *tukmo.*

CHALCOPHAPS INDICA INDICA (Linnæus).

One young female.

The Indian bronze-winged dove was always flushed from under the thick bushes that grew profusely along the shore.

RALLUS TORQUATUS TORQUATUS Linnæus.

One male.

The Philippine rail was rather common in the tracts of grass anywhere in the island. A nest with four eggs was found in an open meadow near an idle ricefield. The sitting bird flushed almost from under the feet of the collector.

HETEROSCELUS BREVIPES (Vieillot).

Three males.

The polynesian tattler was often seen in groups of three to five, feeding on the sandy shores of the southwestern part of the island.

DEMIGRETTA SACRA SACRA (Gmelin).

Two females.

The blue reef heron was a common sight along the lonely shores of the island.

Its native name is *dukó,* from its ever-stooping position.

BUTORIDES STRIATUS JAVANICUS (Horsfield).

One female.

The Javan green heron was often seen feeding in association with the preceding species.

The native name is *kioó.*

SAUROPATIS CHLORIS COLLARIS (Boddaert).

One male.

The white-collared kingfisher was very abundant.

The native name is *takray.*

EURYSTOMUS ORIENTALIS ORIENTALIS (Linnæus).

One male and one female.

A few specimens of the broad-billed roller were observed perching calmly on low trees near the clearings.

COLLOCALIA TROGLODYTES Gray.

One male and one female.

There were two species of swifts commonly seen in flight. The present species was most abundant, hundreds being always observed flying in the vicinity of the lighthouse. The natives informed us of caves in which hundreds of these swifts were nesting. The swifts nesting in the vicinity were most likely the present species and *C. francica germani.*

SURNICULUS LUGUBRIS VELUTINUS (Sharpe).

One female.

The single specimen secured of the Philippine drongo cuckoo has some brown feathers scattered through its otherwise black plumage.

The species has not been recorded from the mainland of Panay.

CACOMANTIS MERULINUS MERULINUS (Scopoli).

One male and one female.

The rufous-bellied cuckoo was common.

EUDYNAMYS SCOLOPACEA MINDANENSIS (Linnæus).

Two males.

The Philippine koel was often seen and heard in the thick bushes near the shore.

The native name is *kuhao.*

CENTROPUS BENGALENSIS JAVANENSIS (Dumont).

One female.

The Javan coucal was often heard singing its mournful notes. Several individuals of the species were flushed from the cogon tracts in the hillsides.

YUNGIPICUS MACULATUS (Scopoli).

One female.

F. S. Rivera secured the single specimen of the spotted pygmy woodpecker in a patch of forest.

HIRUNDO TAHITICA ABBOTTI Oberholser.

One male.

Asiatic swallows were common flying low over the shallow waters in the southeastern shore. Frequently several specimens were seen perching together in some dead trees.

HIRUNDO DAURICA STRIOLATA Temminck and Schlegel.

One female.

This species was not as common as the preceding species.

RHIPIDURA JAVANICA NIGRITORQUIS Vigors.

One male.

The black-and-white fantail flycatcher was often met with in the thick patches of vegetation.

The native name is *saya-saya.*

LALAGE NIGRA CHILENSIS (Meyen).

One male and one female.

Several pied lalage were seen feeding on the insects that were swarming around the fruit clusters of binayoyo.

IOLE PHILIPPENSIS GUIMARASENSIS Steere.

Two males.

Steere's bulbul was often seen and heard in the patches of dwarf trees in the hills.

COPSYCHUS SAULARIS MINDANENSIS (Boddaert).

One male.

The Philippine magpie-robin was common in thick growth bordering the shoreline.

MEGALURUS TWEEDDALEI McGregor.

One male.

Tweeddale's marsh warbler was often heard warbling among the thick growth of mixed tall grass and shrubs, but it was difficult to see. The single specimen secured was taken only after the most difficult task of stalking through very thick growth.

ARTAMUS LEUCORYNCHUS LEUCORYNCHUS (Linnæus).

One female.

The native name is *alagit-it.*

DICÆUM PYGMAEUM (Kittlitz).

One male.

This species has not been recorded from Panay.

LEPTOCOMA JUGULARIS JUGULARIS (Linnæus).

Three males and two females.

The yellow-breasted sunbird was common in the swamp growth.

The native name is *tulamís.*

ANTHUS RUFULUS Vieillot.

Two females.

The Indian pipit was commonly observed in the vacant rice fields and in the open grass tracts. Several individuals could be flushed easily from one such spot.

The native name is *tagsing.*

ORIOLUS CHINENSIS CHINENSIS Linnæus.

One male and one female.

The Philippine oriole was often heard and seen.

APLONIS PANAYENSIS PANAYENSIS (Scopoli).

Three males.

Large flocks of these glossy starlings were often met with.

SARCOPS MELANONOTUS Grant.

One male and one female.

The black-backed coleto was occasionally seen in the small coconut patches.

CORVUS CORONOIDES PHILIPPINUS Bonaparte.

One female.

Crows were very abundant. I could always hear their loud cries wherever I went. The birds were nesting in the dwarfed trees high up among the sheer crags in the southern end.

Fifty-seven specimens, belonging to 31 forms, were collected in North Gigante.

BIRDS FROM SOUTH GIGANTE

TRERON VERNANS VERNANS (Linnæus).

One male and two females.

This species was very abundant.

DUCULA ÆNEA CHALYBURA (Bonaparte).

One male.

F. S. Rivera shot the single specimen of Bonaparte's imperial pigeon. He reported seeing several others, but they were difficult to get at.

STREPTOPELIA BITORQUATA DUSSUMIERI (Temminck).

One male and one female.

Dussumier's turtle dove was very abundant.

COLLOCALIA FRANCICA GERMANI (Oustalet).

One male.

This larger species of the swifts was often seen flying about in North and South Gigante Islands. It makes the commercial edible nests. It was more abundant than its congener, *C. troglodytes*.

CACOMANTIS MERULINUS MERULINUS (Scopoli).

Two males.

The two specimens from the island present different plumage.

CENTROPUS BENGALENSIS JAVANENSIS (Dumont).

One female.

As in the northern island, the species was often met with in cogon growth.

ANTHUS RUFULUS Vieillot.

One male.

Several individuals were seen in the idle rice fields.

APLONIS PANAYENSIS PANAYENSIS (Scopoli).

Two males.

This species was very abundant in the island.

SARCOPS MELANONOTUS Grant.

One female.

The black-backed coleto was more abundant in the southern island than in the northern.

Fourteen specimens, belonging to 9 forms, were collected in South Gigante Island.

BIRDS OBSERVED BUT NOT COLLECTED IN THE GIGANTE ISLANDS

MEGAPODIUS sp.

The species has not been seen but footprints unmistakably belonging to a megapode were rather common in the sandy beaches of both islands, especially in places that border thick

growth. We dined one time on eggs that were unmistakably tabon eggs. The natives secured them in the sandy beaches of the islets around North Gigante Island, notably from Gigantuna and Gigantillo.

The native name of the species is *tabon*.

EXCALFACTORIA CHINENSIS LINEATA (Scopoli).

Several island painted quails were flushed in the short-grass tracts of both islands.

EGRETTA GARZETTA NIGRIPES (Temminck).

Several specimens of the little white egret were seen way out in the shallows which surround the islands.

CUNCUMA LEUCOGASTER (Gmelin).

A pair of white-breasted sea eagles were seen perching on the high sheer cliffs in the southern end of North Gigante Island. F. S. Rivera fired at them, but except for the disturbance caused by the loud explosion, the birds were apparently not bothered in the least, for they calmly winged their way to the other island which at this point is only $\frac{1}{2}$ mile away.

HALIASTUR INDUS INTERMEDIUS Gurney.

Two specimens of the Malayan Brahminy kite were often observed in flight over the central part of the island.

TANYGNATHUS LUCIONENSIS LUCIONENSIS (Linnæus).

One specimen of the Philippine green parrot was seen as a pet in one of the houses in the village of South Gigante. The school teacher in the barrio, a bird enthusiast himself, told us that the species was common in the woods of the island but strangely enough has never been seen in North Gigante. Nests of this parrot could be found in the trees of the forest, and the villagers get the young for pets.

ALCEDO ATTHIS BENGALENSIS Gmelin.

A specimen of the Asiatic kingfisher was seen for the first time in a small open creek in North Gigante. Another specimen was observed in a short tree near the shore of South Gigante.

CAPRIMULGUS sp.

One evening three nightjars were seen in flight over the school plaza in North Gigante. One was uttering the characteristic notes of the species. The natives in South Gigante informed us that the bird could be heard evenings in the open meadows near the village.

MEGALURUS PALUSTRIS FORBESI Bangs.

The striated marsh warbler was observed in both islands, although it was more common in South Gigante, particularly in vacant rice fields.

MUNIA ATRICAPILLA MINUTA (Meyen).

Flocks of this weaver were seen in both islands.

Except for the questionable report of the absence of *Tanygnathus l. lucionensis* in North Gigante, all the birds that were either collected or observed in one island were also found in the other.

Three species, *Megapodius* sp., *Megalurus palustris forbesi*, and *Cuncuma leucogaster*, of the birds that were observed, have not been recorded from Panay.

GENERAL CONSIDERATIONS ON THE AVIFAUNA OF THE ISLANDS

Thirty-three forms of birds were collected from North and South Gigante. If the species that were observed but not collected are added to this number, the number of known species in the Gigante Islands will be 43.

Most of the species that have been found in the islands have been recorded from Panay, except *Megapodius* sp., *Cuncuma leucogaster, Surniculus lugubris velutinus, Megalurus palustris forbesi,* and *Dicæum pygmæum.*

Except *Megapodius* sp. all the above birds have been recorded from Negros and Masbate, which, together with Bantayan, Ticao, and Panay, form the Central Philippine group of McGregor (Dickerson, 1928), based on the similarities of their avifauna.

It is strange that *Megapodius* has not been recorded so far from the important islands of what McGregor (Dickerson, 1928) called the Central Philippine group, except perhaps in Bantayan Island.

SUMMARY AND CONCLUSIONS

The avifauna of the Gigante Islands bears a very close relationship to that of Panay. Most of the species found in the islands have been recorded from Panay, except four, which are however, found in the other islands of the Central Philippine group, and one which has been recorded in one island of the group.

LITERATURE CITED

DICKERSON, ROY., et al. Distribution of Life in the Philippines. Manila (1928) 202.

United States Coast Pilot. Philippine Islands. Part I. Luzon, Mindoro, and Visayas (1927) 209.

BOOKS

Acknowledgment of all books received by the Philippine Journal of Science will be made in this column, from which a selection will be made for review.

RECEIVED

BARRETT, MARY FRANKLIN. A leaf key to Florida broadleaved trees; native and exotic, except palms. The author, c1937. 79 pp.

British Plastics year book, 1938. Handbook and guide to the plastics industry. London, Plastics press, ltd., 1938. 595 pp. Price, 15s.

COLEMAN, HARRY S. Planning and equipping laboratories for research; recent experience at Mellon Institute, 1938. 11 pp.

Glossary of terms relating to rubber, its uses and manufacture. 2d ed. Stamford, Conn., The Stamford Rubber Supply co., 1937. 28 pp.

Mellon Institute. Dedication of the new building to science and humanity for Andrew W. Mellon and Richard B. Mellon. Pittsburgh, Pa., The Institute, 1937. 55 pp.

OSGOOD, EDWIN E., and CLARICE M. ASHWORTH. Atlas of hematology; with three hundred and twenty-five illustrations and a frontispiece in color. San Francisco, J. W. Stacey, inc., c1937. 255 pp.

The physician and our daily bread. N. Y., Dept. of Nutrition of the American Institute of Baking, 1938. 19 pp.

SPRINKLE, LELAND W. Sprinkle's Conversion formulas. Philadelphia, P. Blakiston's Son & Co., inc., c1938. 122 pp.

STROCK, LESTER W. Spectrum analysis with the carbon arc cathode layer. London, Adam Hilger, ltd. 56 pp.

TANNEHILL, IVAN RAY. Hurricanes; their nature and history. Princeton, Princeton University Press, 1938. 257 pp. Price, $3.50.

TRUE, ALFRED CHARLES. A history of agricultural experimentation and research in the United States, 1607–1925. U. S. Department of Agriculture, Miscellaneous Publication No. 251. 321 pp.

REVIEWS

Mechanics, Molecular Physics, Heat, and Sound. By Robert Andrews Millikan, Duane Roller, and Ernest Charles Watson. New York, Ginn and Company, 1937. 498 pp., bibliography, illus., tables. Price, $4.

This book, like Millikan's "Mechanics and molecular physics and heat," is a textbook and a laboratory manual combined. It "stresses a thorough treatment of fundamental principles rather than the presentation of a large mass of facts." It has much interesting historical material which appears either as chapter introduction or plate. Each chapter ends with some experi-

ments, a question summary, and problems. Questions are inserted in the directions for the performance of the experiments, the answering of which will make the student perform the experiment intelligently and help him understand the underlying principle. Calculus is used in some portions of the book, although it is intended "for the serious student who seeks a thorough training in science or engineering, who has already mastered trigonometry and who has had the equivalent of a good secondary school course in physics." Although most of the experiments are the same as those ordinarily given in a first course in college, this book is too difficult to serve as a textbook for a first course in the Philippines. It is more fitted for a second course in college in the Philippines, especially for physics major students, in which case, however, it will have to be used in connection with another book for the laboratory work.

—T. P. A.

Workers' Nutrition and Social Policy. Studies and Reports, Series B (Social and Economic Conditions) No. 23. Geneva, International Labour Office, 1936. 248 pp. Published in the United Kingdom by P. S. King and Sons, Ltd. Distributed in the United States by The World Peace Foundation, 8 West 40th Street, New York City. Price, $1.50.

This report was published by the International Labour Office at Geneva in 1936. It is a fairly detailed survey of the problems of adequate nutrition. The chapter headings indicate the scope of the work. Some of the more important chapters are: Nutrition and Occupation, Facts on Workers' Diet, Agricultural Production and Food Consumption, Social Legislation and Nutrition, Agencies and Methods to Improve Nutrition, Problems of Policy. Important statistical methods and a review of national food regulation appear in the appendices. The work has great merit because it defines the problem as clearly and precisely as possible, and should be read not only by employers and workers but also by legislators and government leaders.

In the chapter entitled "Problems of Policy" the authors of the report state:

All institutions today, political, economic, charitable and religious, are directly or indirectly interested in the building up of a healthy human race. Whatever the ideal of a people may be, its attainment and promotion require a healthy and vigorous population. It is the recognition of this fact which gives meaning and force to the new crusade for a general nutrition policy not only in times of depression but as an element of national policy akin to and on a par with education, housing and similar public policies.

A social nutrition policy is but another concrete application of one of the general principles upon which the International Labour Organisation is founded, namely, the need for the special protection of those groups of the population which because of poverty or other reasons fall below socially desirable minimum standards. In brief, the measures needed to improve workers' dietaries are part of the general programme of the International Labour Organisation for raising living standards in all countries as a condition *sine qua non* of social justice and peace.

This statement is food for thought on the part of the legislators and the leaders of our government, especially at this time when attention is focused on social justice.—I. C.

Faisceau Energétique et Biologie; Biogenése et Pathogenése. Par le Docteur G. Froin. Paris, Librairie Girardot et Cie, 1937. 327 pp., illus. Price, 30 Frs.

The book of Dr. G. Froin under the title "Faisceau Energetique et Biologie" is an interesting book of physical biology which will be appreciated by both the biologists and the physiologists engaged in the various problems of normal and pathological human life.

Human life, in the words of the author, may be considered a simple "burning without flame" in which the atoms and molecules of visible matter, as well as of invisible energetic matter from our sun, play the most important part.

In the pages of this book are studied the sun's energetic matter, its penetration and distribution in the various tissues, and the rôle played in the different functions of the human organism.

Finally, this biogenetic and functional study is accompanied by interesting remarks or considerations in connection with the pathogenesis of certain human diseases.—C. M.

International Aspects of Oceanography; Oceanographic Data and Provisions for Oceanographic Research. By Thomas Wayland Vaughan and others. Washington, D. C., National Academy of Sciences, 1937. 225 pp., plates, charts.

This book presents oceanographic data with a synopsis of information available for the study of several aspects of the ocean. In addition, some references to literature aside from the lists of sources of data are included. The purpose is to give in a brief form the degree of exploration of as nearly all the areas of the ocean as possible. In this way areas in different oceans on which there is no information are brought out. A catalogue of oceanographic institutions for each country is included, giving the provisions for oceanographic research and the scope of oceanographic activities for each. This arrangement makes clear

what is being done in each country on oceanography, information that may be utilized by countries with inadequate provisions for placing their program of oceanographic studies on the same plane as that of other countries, should they desire to do so. The book should serve as a very useful reference to workers on various aspects of oceanography.—D. V. V.

Hurricanes; their nature and history. By Ivan Ray Tannehill. Princeton, Princeton University Press, 1938. 257 pp., illus. Price, $3.50.

In this book an experienced meteorologist gives to the public an interesting description and explanation of the complicated natural phenomenon called the hurricane. With the resources of the United States Weather Bureau Library at his disposal, he has selected incidents very suitable for illustrating his subject matter. For those who know little or nothing about meteorology the book will be instructive and entertaining. For meteorologists who are familiar with the subject of the book, there is an excellent catalogue of hurricanes of the West Indies, together with a bibliography, both valuable for reference.

The first few pages of the book define the tropical cyclone and give the historical development of the methods by which that definition was formed. The progress made after investigations into the nature and cause of these storms leads up to the present technique in detecting their formation and locating their centers after the storm has formed. Separate chapters discuss the various parts of the hurricane, namely the winds and the "eye," the storm wave, rainfall, and destructive effects. In his treatment of the theories concerning the origin of these storms, the author presents the various ideas as to their cause and maintenance, in which he gives credit to work that has been done along these lines at the Manila Observatory. The ordinary and extraordinary tracks of hurricanes and their varying frequency indicate very well the difficulties forecasters have when these storms occur. The author's explanation of precursory signs is the most practical part of the book and can be read with profit in any part of the world frequented by tropical cyclones.

The final part of the book has an excellent list of hurricanes, from the time of Columbus up to the present. Only the most destructive storms in the early years are described. From the beginning of the nineteenth century, because of more complete records, the list is more numerous. All the hurricanes since the beginning of the twentieth century are mentioned. There is a supplement giving the dates of all known West Indian hur-

ricanes since the time of Columbus. An excellent bibliography concludes the book.

Although most of the examples used by the author are taken from hurricanes in the West Indies, his presentation of the subject matter gives the book general usefulness wherever tropical cyclones occur. In the Philippines a wide distribution of this book would make people more familiar with the nature of a typhoon, or baguio (which is the local name for a tropical cyclone), resulting in a better understanding of the typhoon warnings issued during the progress of the storm.—B. F. D.

Introduction to Research on Plant Diseases; A Guide to the Principles and Practice for Studying Various Plant-Disease Problems. By A. J. Riker and Regina S. Riker. St. Louis, John S. Swift Co., Inc., 1936. 117 pp., illus., charts. Price, $2.65.

This book is a collection of methods in plant pathology, put together by Professor Riker and the junior author. The methods are systematized into eleven chapters: foundation of research problems; general laboratory equipment; culture media; certain physical-chemical measurements; isolation, culture, and inoculation; virus diseases; certain procedure for pathological histology; epidemiology, environment, and control; statistical analyses; records and manuscripts; and laboratory exercise topics.

The methods as presented under different chapters facilitate the work of a student or researcher studying the various phases of a problem. With this book as a guide, the tribulations usually experienced by a student in searching through the mass of literature on methods is greatly minimized. Moreover the methods are selected and tested. The index in the book serves as key to other research procedures. It is of course duly recognized that a researcher may occasionally find it necessary to modify or establish methods suitable to the demands of a problem and available facilities.

The discussion gives a student an insight into the proper approach to and the intricacies of the task before him. With the various points briefly discussed under separate topics, and the methods under the different chapters, research students may be ushered more readily into the various phases of a research problem. Teachers in plant pathology, research students, and investigators will find this book a very useful reference. Professor Riker and the co-author are research pathologists with training, experience, and achievement in pathology possessed by few.

—F. M. C.

Exploration Radiologique des Colons et de L'Appendice au Moyen des Solutions Floculantes. By Georges Maingot, Raymond Sarasin, and Henri Duclos. Paris, Masson et Cie., 1935. 229 pp., illus. Price, $13.

This book has presented modern roentgen-ray study of the colon and appendix by the examination of the colon in three stages or parts. The first stage, which is the most classical technique, is the study of the colon after it has been filled with radio-opaque solution (colloidal solution of thorium dioxide). This stage gives certain information as to the form and condition of the colon, but at times the presence of small growths, polyps, diverticula, or ulceration of the mucosa are missed due to the opaque shadow filling up the whole lumen of the colon. For a complete examination another X-Ray study is made just after the evacuation of the enema, and another after insufflation of air, called the double-contrast method. These last two procedures or parts of the examination are necessary in the demonstration of mucosal morphology.

There are also interesting pictures of the appendix presented. The technique is well described, and the different morphological conditions of the colon are well discussed and vividly presented by a great number of illustrations that make the book a good reference for the roentgenologist.—P. S. C.

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DIFFERENTIATION OF CATTLE AND CARABAO MEAT BY BIOCHEMICAL METHODS, I

DIFFERENTIATION OF UNREFRIGERATED AND FROZEN MEAT

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TWO PLATES

A previous paper by one of the authors(1) found only limited application, due to the fact that the carcasses of all kinds of food animals slaughtered in the city abattoir are not subjected to refrigeration between the time they are dressed in the afternoon and the next morning when the meat is sold in the city markets; nor is the meat kept under refrigeration during the market hours the next day. Under such circumstances fermentation proceeds more rapidly under Philippine climatic conditions than in colder climates, and blood cells are hæmolyzed or rendered insusceptible to agglutination. Because of this fact attention was turned to developing a process of differentiation by biochemical methods.

The flesh of carabaos is generally of a much darker red than that of cattle. In view of this observation the hæmoglobin contents of the watery extract of these animals were studied, with the intention of making them the basis of differentiation; but hæmoglobin content was found variable in both cattle and carabaos. The sulfur contents of the extracts of the meat of these animals were also found too variable to be of any value in the differentiation. An attempt was then made to determine the cholesterol content. A rough method for extracting cholesterol by treating finely ground meat with ether gave results showing

that cholesterol is present in the tissue of the two animals, but the amount was again found variable as determined by the acetic anhydride-sulfuric acid test. However, in connection with the study of the cholesterol content it was observed that the ether extract of the meat of cattle was decidedly yellow, while the ether extract of carabao meat was colorless or in some instances had a very faint tinge of yellow. Coronel,(2) who studied the fat of these two animals, found the same yellow color in the ether extract of cattle fat, and no, or in some instances a very faint tinge of, yellow color in the ether extract of carabao fat.

Upon further investigation the appearance of yellow pigment in ether extracts of the tissue of cattle, and the failure to produce this pigment in the case of carabaos, seemed to be constant. On the basis of the assertion of Rogers,(5) citing the findings of Palmer and Eckles that carotene is present in the blood of the cow as an adsorption complex with serum albumin, it was suspected that the yellow pigment was carotene. This suspicion was verified when the yellow residue of cattle meat ether extract gave a positive reaction to the test for carotene described by Rogers,(5) the antimony trichloride ($SbCl_3$) test. A similar positive reaction was observed when the colorless residue of carabao meat extract was tested. Carotene is present in the meat of these two animals, but in the carabao it seems to occur in a different form. No literature is available on the utilization of the difference in the nature of the carotene occurring in the tissue of cattle and carabaos as the basis of differentiation. The object of the present work is to elaborate a qualitative test based on the difference in the nature of carotene occurring in cattle and carabao tissues.

PRELIMINARY EXPERIMENTAL INVESTIGATIONS

EXPERIMENT 1. DETERMINATION OF THE PRESENCE OF CAROTENE IN CATTLE AND CARABAO TISSUE

In view of observations made during preliminary studies on the cholesterol content of cattle and carabao flesh, and on the findings of Coronel(2) in his study of the fat of these two animals, a study to determine the presence of carotene in the lean flesh of cattle and carabaos was undertaken.

Method.—A practical method for the extraction of carotene from cattle and carabao tissue was evolved from the statement of Rogers(5) that carotene in association with protein can be readily isolated, that it easily disperses in water, and that the

solution, like the dry form, does not give up its carotene to fat solvents unless first treated with alcohol. The method consists of the treatment of the ground meat with absolute alcohol for 30 minutes, followed by 30 minutes of extraction with ether, regarded as one of the good solvents of carotene. For the determination of whether the ether extracts obtained by this method contain carotene, they are evaporated and the residues tested with antimony trichloride solution.

Materials.—Ten samples of cattle and 10 of carabao meat were secured from the Azcarraga abattoir soon after the carcasses were dressed.

Apparatus.—The apparatus used were a Universal meat grinder, the smallest size (No. 00) so that even a small piece of meat can be ground through, a small Troemner balance (0.1 to 8 g capacity), an electric water bath with concentric rings to accommodate different sizes of evaporating dishes, 30 cc capacity white glass wide-mouthed bottles, small glass funnels, filter paper, 25 cc capacity Coors porcelain evaporating dishes, a 10 cc graduate, corks to fit the bottles, and tin foils.

Reagents.—Reagents used were Merk's absolute alcohol, Squibb's anæsthesia ether, dry chloroform (Mallinkrodt chloroform, C. P.) dried by addition of a few crystals of calcium chloride, a 28 per cent solution of antimony trichloride in chloroform, and 0.02 per cent aqueous solution of $K_2Cr_2O_7$ as color standard.

Procedure.—All visible fats are removed from the meat sample, and the sample ground through the meat grinder three times. Five grams of the finely ground meat is weighed into a bottle, 10 cc of absolute alcohol added, and the bottle covered with cork wrapped in tin foil. The alcohol is allowed to act, with frequent shaking, for 30 minutes. The alcohol is then decanted and 10 cc of ether added to the meat sample. Ether extraction is carried on for 30 minutes with frequent shaking. The ether extract is then filtered through Schleicher and Schull analytical filter paper No. 589, the filtrate caught in a Coors porcelain evaporating dish, and the intensity of its yellow coloration recorded by ocular comparison with an equal amount of a color standard consisting of 0.02 per cent aqueous solution of potassium dichromate in a Coors porcelain evaporating dish of the same size. The filtrate is evaporated to dryness in the steaming waterbath, and the color of the residue recorded. The residue is then tested for carotene according to the method cited by Rogers (5)

by dissolution in 1 cc dry chloroform, and the solution poured in a test tube to which 2 cc of the $SbCl_3$ solution is added. Upon addition of $SbCl_3$ solution a color reaction develops which ranges from pinkish violet to dark blue.

Results.—Each of the 10 cattle and the 10 carabao samples was treated in the manner described above, and it was found that the filtrates of the 10 cattle meat samples were colored yellow in varying intensity, with the exception of 1 which gave a very faint yellow filtrate. When evaporated, all gave an orange-yellow residue of varying amount. On the other hand, the filtrates of the 10 carabao samples were found colorless, with the exception of 2, which gave a very faint yellow tinge, and when evaporated, 8 gave a colorless residue and 2 a light greenish-yellow residue which was markedly different from the residue obtained from cattle filtrates. The residues of both cattle and carabao filtrates gave positive reaction with antimony trichloride. The results are summarized in Table 1.

TABLE 1.—*Color intensity of filtrate, color of residue, and results of $SbCl_3$ test, in cattle and carabao meat samples, where 4+ = 0.02 per cent $K_2Cr_2O_7$ or more; 3 + = about 0.015 per cent $K_2Cr_2O_7$; 2 + = about 0.01 per cent $K_2Cr_2O_7$; 1 + = about 0.005 per cent $K_2Cr_2O_7$; + = very faint yellow; — = colorless.*

Sample.	Cattle.			Carabao.		
	Color intensity of filtrate.	Color of residue.	$SbCl_3$ test.	Color intensity of filtrate.	Color of residue.	$SbCl_3$ test.
1	2+	Orange yellow.	Violet	—	None	Violet.
2	3+	do	Dark blue	—	do	Dark blue.
3	2+	do	Violet	—	do	Violet.
4	4+	do	Dark blue	—	do	Blue.
5	3+	do	do	±	Light greenish yellow.	Violet.
6	3+	do	Blue	—	None	Violet.
7	2+	do	Violet	±	Light greenish yellow.	Blue.
8	±	do	Pinkish violet	—	None	Violet.
9	2+	do	Violet	—	do	Pinkish violet.
10	1+	do	Pinkish violet	—	do	Do.

EXPERIMENT 2. DETERMINATION OF THE PRESENCE OF CAROTENE IN CATTLE AND CARABAO TISSUE BY JOHNSON'S METHOD

According to Rogers (5) the color reaction of carotenoids with strong acids or chlorides of polyvalent elements, not excluding

the antimony trichloride tests, is not specific for carotenoids but is also given by all substances with polyene structure. Hence, to determine whether the positive reactions with antimony trichloride of the cattle and carabao residues, described in the preceding experiment, were not due to substances of polyene structure other than carotenoid, six samples of cattle meat and six samples of carabao meat were tested for carotene by Johnson's method.

Principle.—Johnson's method as described by Kolmer and Boerner(3) consists in the dehydration of serum with plaster of paris and the moistening of the ensuing powdery mass with absolute alcohol to make a thick paste. The paste is then thoroughly shaken with petroleum ether of low boiling point. The yellow coloration of the petroleum ether indicates carotene, because the extraction of pigment from alcohol-moistened serum is equivalent to extracting a pigmented substance from 80 to 90 per cent alcohol, which indicates that the substance is carotene.

Materials.—Six cattle meat and six carabao meat samples were secured from the Azcarraga abattoir soon after the carcasses were dressed. These samples were kept in a refrigerator until the next morning, when they were used in this experiment.

Apparatus.—The apparatus used were a small meat grinder (Universal No. 00), a small mortar and pestle, a small spatula, a Troemner balance, an electric water bath with concentric rings to accommodate different sizes of dishes or flasks, test tubes, small funnels, Coors porcelain evaporating dishes, corks, and tin foil.

Reagents.—Plaster of paris, Merck's petroleum ether (C. P., 30° to 70° C.), Merck's absolute alcohol, dry chloroform, and a 28 per cent antimony trichloride solution in chloroform were used.

Procedure.—For this experiment the meat sample was prepared for use in the same manner as in the preceding experiment. One gram is weighed and placed in a mortar. It is then triturated and dehydrated with about 3 grams of plaster of paris. The powdery mass is moistened with absolute alcohol into a thick paste and placed in a test tube with a spatula. Three cc of petroleum ether is then added to the paste and shaken thoroughly. The petroleum ether layer is allowed to separate, filtered through filter paper, and the filtrate caught in a Coors porcelain evaporating dish, where it is evaporated to dryness over a steaming water bath. The residues of every

two samples of the same kind are dissolved in 1 cc of dry chloroform and tested with 2 cc of 28 per cent $SbCl_3$ solution in chloroform.

Results.—The six cattle meat and the six carabao meat samples were treated in the manner described above. Four of the cattle meat samples produced distinct yellow coloration of the petroleum ether and 2 very slight coloration only, while none of the carabao samples produced any discernible coloration. However, when the filtrates of the cattle and carabao meat samples were evaporated, both the cattle and the carabao filtrates gave yellow fatty residues. The residues from cattle filtrates were of a deeper yellow color than those of the carabao filtrates, and both gave a positive carotene reaction of more or less equal strength with $SbCl_3$ solution.

DIFFERENTIATION OF CATTLE AND CARABAO MEAT BY BIOCHEMICAL METHODS

From the two preliminary experiments two methods of differentiation of cattle and carabao meat by biochemical process were developed. The first method is based on the difference in the color of the residue of the filtrate of ether extract of the meat samples described in the preliminary experiment. The second method is a short cut of the first method.

FIRST METHOD (EVAPORATION METHOD)

Principle.—The principle utilized in this method is practically the same as that described in the first preliminary experiment, with some rather important changes in the reagents used and in the procedure. These alterations make necessary a description of this method in detail.

Materials.—One hundred eleven cattle samples from 111 different animals were obtained as soon as the carcasses were dressed. An equal number of carabao samples were secured in the same manner. The samples were kept in a cool room instead of in an ice box or refrigerator, so that they would be in a condition similar to that of the meat sold in the city markets. Some samples were intentionally exposed further at room temperature to putrefy, and then tested.

Apparatus.—The apparatus, glasswares, and other accessories used were the same as those enumerated in preliminary experiment 1.

Reagents.—Merck's absolute alcohol, Squibb's anæsthesia ether or a mixture of 2 volumes of Squibb's ether and 1 volume of benzine of low boiling point, were used.

Procedure.—The sample is prepared in the same manner as in the preceding experiments. Five grams of the finely ground meat is weighed and placed in a 30 cc wide-mouthed bottle, 10 cc of absolute alcohol added, and the bottle covered with a cork wrapped in tin foil. The alcohol is allowed to act, with frequent shaking, from 5 to 30 minutes. The time allowed for alcohol treatment can be varied, but should not be less than 5 minutes; the longer the time the better the results. The alcohol is decanted and 10 cc of ether alone or 10 cc of the ether-benzine mixture added. Extraction by the fat solvent is carried on from 5 to 30 minutes with frequent shaking. While the extraction is going on, the color of the supernatant is watched. Extraction with ether-benzine mixture gives practically the same results as extraction with pure ether, except that the former gives a clearer supernatant than that obtained with the latter, which is rather turbid and clouds the presumptive reading of results. The longer the action of ether or ether-benzine mixture is carried past 5 minutes the better the result. The extract is then filtered through a Schleicher and Schull paper into a small Coors porcelain evaporation dish. The filtrate is evaporated over a steaming electric water bath, and with the aid of a pair of dish tongs the dish is rotated slightly so that the oily pigmented substance which forms as the ether evaporates does not adhere on the sides of the dish. It will be observed that as soon as most of the ether is evaporated with the watery alcohol portion of the filtrate remaining, the pigmented substances separate out as oily globules, which in the case of cattle filtrates are orange-yellow, and in the case of the carabao filtrates colorless or light greenish yellow. In the dry state these pigmented oily globules present the physical characteristics of butter fats.

Reading and recording of results.—Presumptive reading: As soon as the ether or ether-benzine extraction is finished, the color of the supernatant is determined; if it is yellow, a presumptive identification is entertained that the sample is cattle meat, if colorless, that the sample is carabao meat. The presumptive reading is checked when the extract is filtered into a Coors porcelain dish, where the coloration can be noted more distinctly.

Final reading: The quantity and color of the residue are noted and recorded as follows:

++++, abundant, orange-yellow.
+++, slightly less abundant, orange-yellow.
++, moderate amount, orange-yellow.

+, few clumps, orange-yellow.
±, two or more minute clumps, orange-yellow.
—, practically colorless.

The test of one sample is completed in about 30 minutes.

Results.—Out of the 111 cattle samples tested, 110 gave orange-yellow residues in varying amounts, and 1, which was a badly putrefied sample, gave negative results. Of the 111 carabao samples none gave orange-yellow residues, 99 gave practically colorless residues, and 12 gave light greenish-yellow residues. These results are tabulated in Table 2. (Plate 1.)

TABLE 2.—*Results of tests on 111 cattle and 111 carabao samples by the evaporation method.*

[Legend: yyyy, Very markedly yellow; yyy, markedly yellow; yy, yellow; y, pale yellow; ±y, faint yellow; ?y, barely visible yellow; —, colorless. ++++, Abundant, orange-yellow; +++, less abundant, orange-yellow; ++, moderate amount of orange-yellow; +, few small clumps of orange yellow; ±, two or more minute clumps of orange-yellow; —, practically colorless.]

Sample.	Cattle.			Carabao.		
	Condition.	Ether or ether-benzine filtrate.	Residue.	Condition.	Ether or ether-benzine filtrate.	Residue.
1	Good	yy	++	Good	—	—
2	do	yyy	+++	do	—	—
3	do	yy	++	do	—	—
4	do	yyyy	++++	do	—	—
5	do	yyy	+++	do	?y	Pale greenish yellow.
6	do	yyy	+++	do	—	—
7	do	yy	++	do	?y	Pale greenish yellow.
8	do	±y	±	do	—	—
9	do	yy	++	do	—	—
10	do	y	+	do	—	—
11	Souring	yy	++	Souring	?y	Pale greenish yellow.
12	do	y	+	do	—	—
13	do	y	+	do	—	—
14	do	yyyy	++++	do	—	—
15	do	y	+	do	—	—
16	do	yyyy	++++	do	—	—
17	do	yyyy	++++	do	—	—
18	do	yy	++	do	?y	Pale greenish yellow.
19	do	yyy	+++	do	—	—
20	do	y	+	do	—	—
21	do	yyyy	++++	do	—	—
22	do	y	+	do	—	—
23	do	yyyy	++++	do	—	—
24	do	y	+	do	—	—
25	do	y	+	do	—	—
26	do	yy	++	do	—	—
27	do	yyy	++++	do	—	—
28	do	yy	++	do	—	—

TABLE 2.—*Results of tests on 111 cattle, etc.*—Continued.

[Legend: yyyy, Very markedly yellow; yyy, markedly yellow; yy, yellow; y, pale yellow; ±y, faint yellow; ?y, barely visible yellow; —, colorless. + + + +, Abundant, orange-yellow; + + +, less abundant, orange-yellow; + +, moderate amount of orange-yellow; +, few small clumps of orange yellow; ±, two or more minute clumps of orange-yellow; —, practically colorless.]

Sample.	Cattle.			Carabao.		
	Condition.	Ether or ether-benzine filtrate.	Residue.	Condition.	Ether or ether-benzine filtrate.	Residue.
29	Souring	yyyy	++++	Souring	?y	Pale greenish yellow.
30	do	yyy	+++	do	—	—
31	Good	yyyy	++++	Good	—	—
32	do	y	++	do	—	—
33	do	yyyy	++++	do	—	Pale greenish yellow.
34	do	yyy	++++	do	—	—
35	do	yy	++	do	—	—
36	do	yyyy	++++	do	—	—
37	do	yyy	+++	do	—	—
38	do	yyyy	++++	do	—	—
39	do	yyyy	+++	do	—	—
40	do	yy	+	do	—	—
41	do	yyy	++++	do	—	—
42	do	y	++	do	—	—
43	Beginning to putrefy.	yyy	+++	Fair	—	—
44	do	yyyy	++++	Beginning to putrefy.	—	—
45	do	yyyy	++++	do	—	—
46	Fair	y	++	Good	—	—
47	do	yyyy	++++	Souring	—	—
48	do	y	+	do	—	—
49	do	y	+	Fair	—	—
50	do	yy	++	do	—	—
51	do	y	+	Good	?y	Pale greenish yellow.
52	Good	yyyy	++++	do	—	—
53	do	yy	++	do	—	—
54	do	yyyy	++++	do	—	—
55	do	yyy	++++	do	—	—
56	do	yyyy	++++	do	—	Pale greenish yellow.
57	do	yyyy	++++	do	—	—
58	do	yyy	++++	do	?y	Pale greenish yellow.
59	do	yyyy	++++	do	—	—
60	do	y	+	do	—	—
61	do	yyyy	++++	Putrefying	—	—
62	Putrefying	yyyy	++++	do	—	—
63	do	yyy	++++	do	—	—
64	do	yyyy	++++	do	—	—
65	do	yyy	++++	do	—	—
66	do	y	+	do	—	—
67	do	yyyy	++++	do	—	—
68	do	yyy	++++	do	—	—

TABLE 2.—*Results of tests on 111 cattle, etc.*—Continued.

[Legend: yyyy, Very markedly yellow; yyy, markedly yellow; yy, yellow; y, pale yellow; ±y, faint yellow; ?y, barely visible yellow; —, colorless. + + + +, Abundant, orange-yellow; + + +, less abundant, orange-yellow; + +, moderate amount of orange-yellow; +, few small clumps of orange yellow; ±, two or more minute clumps of orange-yellow; —, practically colorless.]

Sample.	Cattle.			Carabao.		
	Condition.	Ether or ether-benzine filtrate.	Residue.	Condition.	Ether or ether-benzine filtrate.	Residue.
69	Putrefying	y	+	Putrefying	—	—
70	do	y	++	do	—	—
71	do	—	—	Fair	—	—
72	Frozen	yyyy	+++	do	—	—
73	do	yyyy	++++	do	—	—
74	do	yyyy	+++	do	?y	Pale greenish yellow.
75	do	yyy	++++	do	—	—
76	do	yyyy	++	do	—	—
77	do	yyy	++++	do	—	—
78	do	yyyy	++++	do	—	—
79	do	yyy	+++	do	—	—
80	do	yyyy	+++	do	—	—
81	do	yyy	++++	do	—	—
82	Beginning to putrefy.	yyyy	++++	do	—	—
83	do	y	+	do	—	—
84	do	yyyy	++++	do	—	—
85	do	yyyy	+++	do	—	—
86	do	yyyy	+++	do	—	—
87	do	yyyy	++++	do	—	—
88	do	yyyy	+++	do	—	—
89	do	yy	++	do	—	—
90	do	yyyy	++++	do	—	—
91	do	yyy	++++	Beginning to putrefy.	—	—
92	Fair	yyyy	++++	Fair	—	—
93	do	yyyy	++++	do	—	—
94	do	yyyy	++++	do	—	—
95	do	yy	+++	do	—	—
96	do	yyy	+++	do	—	—
97	do	yyyy	++++	do	—	—
98	do	yyy	++++	do	—	—
99	do	yy	+++	do	—	—
100	do	yyyy	++++	do	—	—
101	do	yyyy	++++	do	?y	Pale greenish yellow.
102	do	yyyy	++++	do	—	—
103	do	yyyy	+++	do	—	—
104	do	yyy	+++	do	—	—
105	do	yyyy	++++	do	—	—
106	do	yyyy	++++	do	—	—
107	do	yyy	++++	do	—	—
108	do	yyyy	+++	do	—	—
109	do	yyyy	++++	do	—	—
110	do	yyyy	+++	do	—	—
111	do	yyyy	++++	do	—	—

SECOND METHOD (DIRECT READING)

Principle.—This method is a short cut of the evaporation method. For reasons given above, the ground sample is first treated with absolute alcohol. After the alcohol treatment, and without decanting the alcohol, a mixed fat solvent is added. The solvent used is a mixture of anhydrous ethyl ether and benzine, or petroleum ether of low boiling point. According to Rogers (5) ethyl ether is a fairly good solvent of carotenes, but petroleum ether is a better solvent of alpha carotene. It was therefore expected that a mixture of these two will result in an efficient solvent of the pigment. By trial it was found that a mixture of anhydrous ethyl ether distilled over sodium gave better results than a mixture of Squibb's anæsthesia ether and petroleum ether. The absolute alcohol is reduced to about 75 per cent alcohol by adsorption of moisture from the tissues. With the addition of ethyl ether-petroleum ether mixture, the ethyl ether portion mixes with the alcohol, and the reduced strength of the alcohol allows the petroleum ether to separate as a layer on the top, carrying with it the pigment extracted by the resulting ethyl ether-alcohol mixture. The coloration of the petroleum ether layer at the top is the basis of differentiation by this method.

Materials.—Sixty-five cattle meat samples from 65 different carcasses and 63 carabao meat samples from 63 carcasses were obtained. The samples were kept at room temperature until the next morning, when they were subjected to the test. This procedure was followed to simulate the condition of meat sold in the city markets.

Apparatus, glassware, and other accessories.—The apparatus used were the same as those used in preliminary experiment 1.

Reagent.—Merck's absolute alcohol, a mixture of equal volumes of Baker's anhydrous ethyl ether distilled over sodium and Merck's purified petroleum ether, C. P., 35° C., and color standards consisting of aqueous solutions of $K_2Cr_2O_7$ of different strengths from 0.005 per cent to 0.04 per cent were used.

Procedure.—As in the preceding experiments, all the visible fats are removed from the sample and the sample put through the meat grinder three times. Five grams of meat is weighed into a 30 cc wide-mouthed bottle and 10 cc of alcohol added. A cork wrapped in tin foil is fitted to the bottle and the alcohol-meat mixture is shaken for 5 minutes. Then, without decanting

the alcohol, 8 cc of the anhydrous ethyl-ether petroleum-ether mixture is added and shaken from 1 to 3 minutes. In the case of the cattle meat sample, after the first or second minute of shaking the coloration of the petroleum ether will become apparent. In the case of the carabao meat sample no coloration will be produced; if any color appears at all it is so faint that it can barely be distinguished (Plate 2).

Reading and recording of results.—After the first minute of shaking on the addition of the ether-benzine mixture, the benzine is allowed to separate and examined for yellow coloration by ocular examination. If no coloration is obtained, shaking is resumed for another minute, and the benzine is again allowed to separate on the top and examined for coloration. Three minutes is the maximum time of shaking. The intensity of coloration of the benzine is compared with color standards consisting of aqueous solution of $K_2Cr_2O_7$ as used by Willstater-Stoll(4) in the estimation of carotene in butter fat. The solutions of $K_2Cr_2O_7$ used as color standards are 0.04 per cent, 0.03 per cent, 0.02 per cent, 0.01 per cent, and 0.005 per cent, and the readings on the color of the benzine layer are recorded as follows:

INTENSITY $K_2Cr_2O_7$

++++, ranging from 0.03 per cent to 0.04 per cent.
+++, ranging from 0.02 per cent to 0.03 per cent.
++, ranging from 0.01 per cent to 0.02 per cent.
+, ranging from 0.005 per cent to 0.01 per cent.
±, below 0.005 per cent.
?, very faint, barely visible.
—, no coloration.

To identify the sample producing coloration lower than 0.005 per cent $K_2Cr_2O_7$, its benzine layer together with the small amount of the alcohol-ethyl-ether layer is pipetted out, placed into a small Coors porcelain evaporating dish, and evaported over the steaming water bath. If the meat is cattle meat, the resulting residue will be orange-yellow; if it is carabao meat, the residue is light greenish yellow. The same reaction was observed in the first (evaporation) method. The test of one sample is completed in about 10 minutes.

Results.—Of the 65 cattle samples, 16 gave ++++ reactions, 26 +++, 17 ++, 5 +, and 1 ± which still was plainly more intense than any coloration thus far produced by carabao samples, and when evaporated the benzine layer gave orange-yellow

residues. Of the 63 carabao samples 59 gave negative reactions, and 4 produced very slight colorations of the benzine layer, and when evaporated gave light greenish-yellow residues. The results are tabulated in Table 3.

TABLE 3.—*Results of testing 65 cattle and 66 carabao samples by the direct method.*

[Legend: + + + +, Color intensity ranging from 0.03 per cent to 0.04 per cent $K_2Cr_2O_7$; + + +, color intensity ranging from 0.02 per cent to 0.03 per cent $K_2Cr_2O_7$; + +, color intensity ranging from 0.01 per cent to 0.02 per cent $K_2Cr_2O_7$; +, color intensity ranging from 0.005 per cent to 0.01 per cent $K_2Cr_2O_7$; ±, color intensity below 0.005 per cent $K_2Cr_2O_7$; ?, color very faint, hardly visible; —, colorless.]

Sample.	Cattle.		Carabao.	
	Condition.	Coloration of benzine layer.	Condition.	Coloration of benzine layer.
1	Good	++++	Good	—
2	do	++++	do	—
3	Fair	++++	Fair	?
4	do	+++	do	—
5	do	+++	do	—
6	do	++++	do	?
7	do	++++	do	—
8	do	++++	do	—
9	Frozen	+++	Good	—
10	do	++++	do	—
11	do	+++	do	—
12	do	++++	do	—
13	do	++++	do	—
14	Good	+++	do	—
15	do	+++	do	—
16	do	++	do	—
17	do	+++	do	—
18	do	++	do	—
19	do	+++	do	—
20	do	+++	do	—
21	do	++++	do	—
22	do	+++	do	—
23	do	+++	do	—
24	do	++	do	—
25	do	++	do	—
26	do	+	do	—
27	do	++	do	?
28	Fair	+++	do	—
29	do	+++	do	—
30	do	++	Fair	—
31	do	++++	do	—
32	do	+++	do	—
33	do	++++	do	—
34	do	+++	do	—
35	do	++	do	—
36	do	++	do	?
37	do	++	Beginning to putrefy	—
38	Souring	++	do	—
39	do	++	do	—

TABLE 3.—*Results of testing 65 cattle and 66 carabao samples by the direct method*—Continued.

[Legend: + + + +, Color intensity ranging from 0.03 per cent to 0.04 per cent $K_2Cr_2O_7$; + + +, color intensity ranging from 0.02 per cent to 0.03 per cent $K_2Cr_2O_7$; + +, color intensity ranging from 0.01 per cent to 0.02 per cent $K_2Cr_2O_7$; +, color intensity ranging from 0.005 per cent to 0.01 per cent $K_2Cr_2O_7$; ±, color intensity below 0.005 per cent $K_2Cr_2O_7$; ?, color very faint, hardly visible; —, colorless.]

Sample.	Cattle.		Carabao.	
	Condition.	Coloration of benzine layer.	Condition.	Coloration of benzine layer.
40	Souring	++++	Begining to putrefy	—
41	do	+++	do	—
42	do	+++	do	—
43	do	++++	do	—
44	do	++++	do	—
45	do	+	do	—
46	do	+++	do	—
47	do	+++	Souring	—
48	do	++++	do	—
49	do	+	do	—
50	do	+++	do	—
51	do	++	do	—
52	do	++	do	—
53	do	+++	do	—
54	do	++	do	—
55	do	+++	do	—
56	do	++	do	—
57	do	+++	do	—
58	do	+++	do	—
59	do	+++	do	—
60	do	+	do	—
61	do	+	do	—
62	do	++	do	—
63	do	+++	do	—
64	do	++	Good	—
65	do	±	do	—
66	do		do	—

DISCUSSION

Preliminary experiment 1 shows clearly that carotene is present in cattle and carabao tissues, although it seems to occur in different forms. The difference in color of the residue of their ether extract or ether-benzine extract cannot be taken as an indication of the difference in the concentration of amounts of carotene in the tissue of the two animals, because in some cases even the colorless carabao residue gave a stronger reaction with the antimony trichloride test. Another evidence that carotene occurs in different forms in the tissue of these animals is the observation derived from preliminary experiment 2, where

the colorless benzine extract of carabao tissue evaporated to dryness gave light-yellow oily residue which also gave just as strong positive reaction with antimony trichloride solution as given by the deeper colored yellow oily residue of the benzine extract from cattle tissue.

It is obvious that by the methods of extraction used in this work carotene is not extracted in pure form but in association with some fatty substances; but even in such impure state it can be recognized in the cattle and carabao tissue in more or less equal quantities, although in the latter animal it appears to occur in a different form. Carotene in carabaos seems to occur in hydrogenated form, like the octadecahydrocarotene or dihydrocarotene described by Smith,(6) the first substance as a colorless, oily product, and the second, as a viscous, noncrystallizable, pale-yellow substance which in solution of minute quantity may not be capable of imparting color to the solvent; while the carotene present in cattle tissue is of the highly colored form, like alpha carotene or beta carotene, which in solution even in minute quantities imparts visible color to the solvent. This difference in the nature of the carotene occurring in these two animals was taken advantage of in the differentiation of their flesh by the foregoing methods.

In the endeavor to develop methods of differentiation of the meat of the two animals treated in this work, it has always been the prime aim of the authors to find a simple rapid test, easy in procedure, requiring simple apparatus and reagents which are stable, so that no error can arise from deteriorating reagents or mixtures of reagents, and which possesses a high degree of accuracy so that it can be performed by veterinarians without special laboratory training. It is believed that these requirements are met by the two methods herein described. Although the total carotene content is not extracted in either of the two methods described, these methods give easily readable results, and thus far, as supported by the data included in this work, they possess a high degree of accuracy. As to rapidity, by the evaporation method the test of one sample can be finished in a half hour, and by the direct method in 10 minutes.

It has been found in a few trials that these methods may be useful in differentiating treated materials; such as meat boiled with condiments, fried in lard, or salted and dried. This phase of the problem will be treated in a subsequent work.

CONCLUSIONS

1. There is strong evidence of the presence of carotene in the tissues of cattle and carabaos, but in the latter animals it seems to occur in a different form.

2. Differentiation of unrefrigerated and frozen meat of cattle and carabaos is practicable by the two methods described; these methods are based on the difference in the nature of carotene present in the tissues of these two animals.

ACKNOWLEDGMENT

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ILLUSTRATIONS

PLATE 1

Color of residues obtained from representative cattle-meat and carabao-meat samples by the evaporation method.

PLATE 2

Coloration of benzine layer obtained from representative samples of cattle meat and carabao meat by the direct reading method.

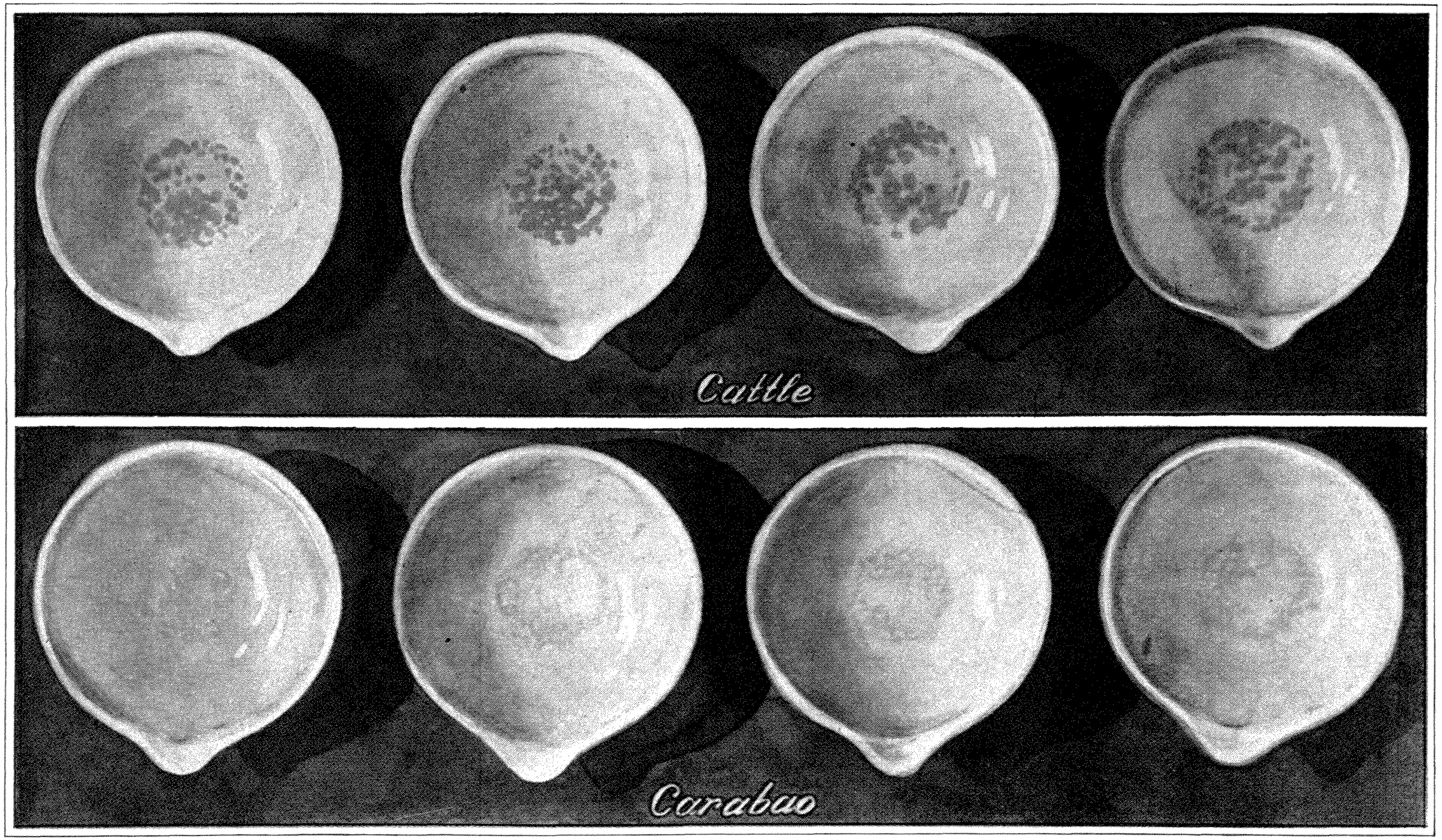

PLATE 1. COLOR OF RESIDUES OBTAINED FROM REPRESENTATIVE CATTLE-MEAT AND CARABAO-MEAT SAMPLES BY THE EVAPORATION METHOD.

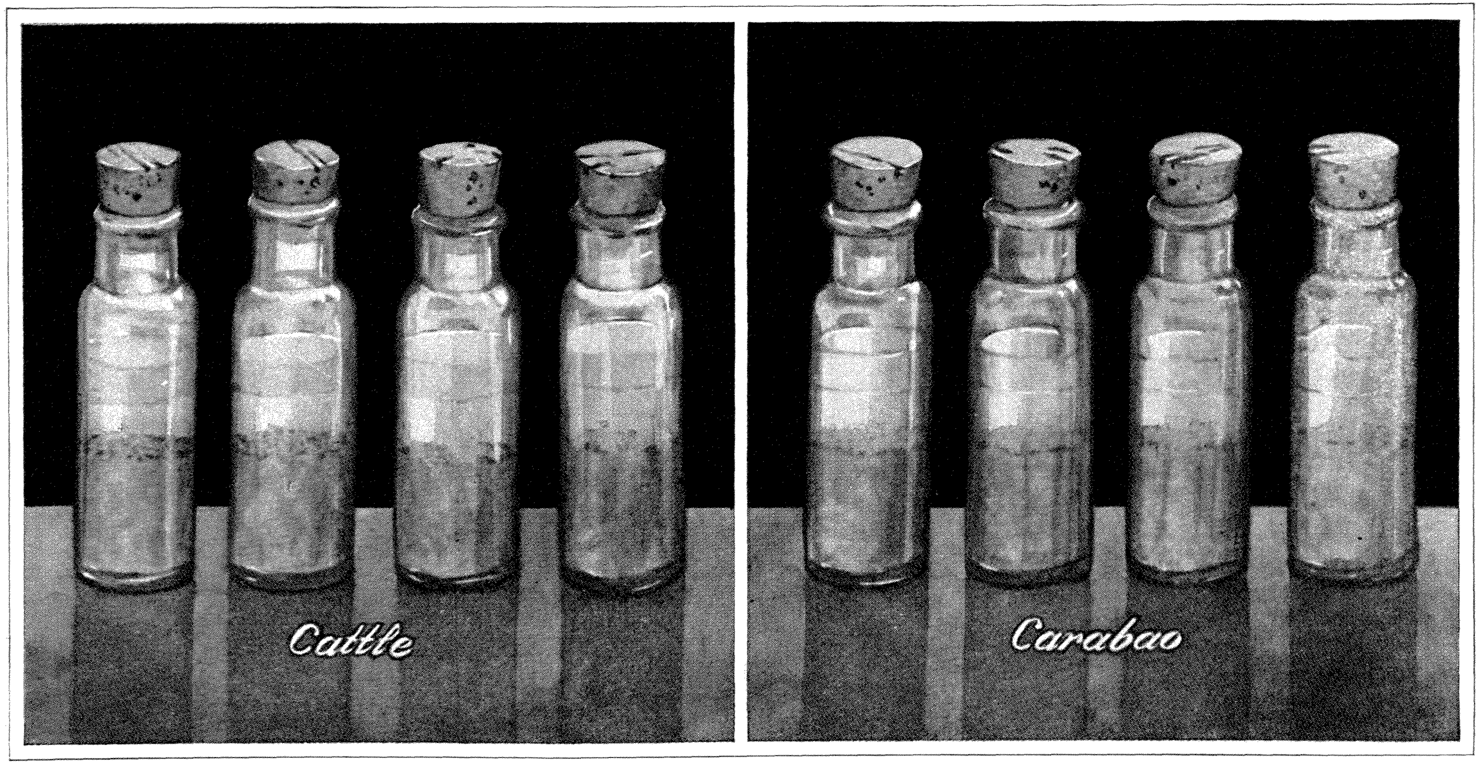

PLATE. 2. COLORATION OF BENZINE LAYER OBTAINED FROM REPRESENTATIVE SAMPLES OF CATTLE MEAT AND CARABAO MEAT BY THE DIRECT READING METHOD.

DESCRIPTION OF THREE TREMATODES OF THE GENUS HAPLORCHIS (HETEROPHYIDÆ) WITH NOTES ON TWO OTHER PHILIPPINE MEMBERS OF THIS GENUS.[1]

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TWO PLATES

In this paper are described two new species of heterophyid trematodes belonging to the genus *Haplorchis.* In addition *Monorchotrema calderoni* Africa and Garcia (1935) which, in accordance with the recent studies of Chen (1936), apparently establishing the synonymy of the genus *Monorchotrema* and the genus *Haplorchis,* should now be called *Haplorchis calderoni* (Africa and Garcia, 1935), is redescribed and refigured because of some errors lately found in the original description. Brief notes on *Haplorchis yokogawai* (Katsuta, 1932) Chen, (1936) and *H. taichui* (Nishigori, 1924) Chen (1936) are also included.

HAPLORCHIS CALDERONI (Africa and Garcia, 1935). Plate 1, fig. 1.

In the revision of the original description of this species a considerable number of mounted specimens were restudied. In addition a large number of specimens in various stages of development from the freshly excysted to the adult stage, obtained from experimentally infected animals, were studied in the fresh state. This study afforded an excellent opportunity to determine the structure of the ventrogenital sac, especially the spines ornamenting the surface of the gonotyl which are very difficult to see in mounted stained adult specimens.

Body small, 0.47 to 0.55 mm long, 0.25 to 0.26 mm wide, pear-shaped, covered with scalelike spines except at posterior end. Oral sucker subterminal, 0.05 mm in diameter; prepharynx short; pharynx ovoid, 0.03 mm by 0.027 mm; œsophagus long and capillary, 0.150 mm long, 0.015 mm wide; intestinal cæca

[1] Aided by a special research grant from the Board of Regents, University of the Philippines.

tubular, extending to posterior end of body, beyond posterior border of testis.

Genital sac ringlike, 0.035 to 0.040 mm in diameter, situated in the median line immediately behind intestinal bifurcation and occupied by a small protrusible gonotyl ornamented with extremely minute spines generally distributed within a circular area, 0.010 to 0.015 mm in diameter in its central surface. At the bottom of the genital sac, and continuous with the gonotyl, is the rudimentary acetabulum, 0.021 to 0.035 mm in diameter.

The single, large, spherical or slightly ovoid testis, 0.108 to 0.126 mm in diameter, occupies the median field of the posterior third of the body. The seminal vesicle consists of three very unequal parts; the first or posterior portion is a small ovoid thin-walled sac, 0.047 mm long, 0.042 mm wide, bent under the very much larger and longer second or expulsor portion from which it is separated by a short constriction. The expulsor is enormously long, 0.23 to 0.35 mm long, 0.035 to 0.056 mm wide, with a thick (0.0035 to 0.0040 mm) chitinized wall, running alongside and under the left cæcum towards the ventrogenital sac where it terminates by a short ejaculatory duct in common with the vagina. Ovary roundish, 0.055 to 0.080 mm in diameter, situated in the right side of the body about halfway between the testis and the ventrogenital sac. Receptaculum seminis spherical, 0.070 to 0.103 mm in diameter, situated at the right side opposite the seminal vesicle, between the testis and the ovary. The oviduct descends from the inferior border of the ovary and meets the tube coming from the receptaculum seminis to form a common duct which proceeds medially towards the oötype. The uterus descends at the left side of the body, and after describing several coils in the posterior half of the body ascends at the right side alongside the right cæcum and then turns medially toward the ventrogenital sac where it terminates in a vagina with denticulated inner lining in common with the ejaculatory duct. The vitellaria are composed of small follicles arranged in groups distributed in the posterior third of the body behind the seminal vesicle.

Eggs, 0.021 to 0.025 mm by 0.011 to 0.015 mm.

Hosts.—Dogs, cats, and man.

Location.—Small intestine.

Locality.—Manila, Philippines.

Type specimens and paratypes in the Parasitological Collection, Department of Parasitology, School of Hygiene and Public Health, University of the Philippines.

Haplorchis calderoni differs from all other species of the genus by the extraordinarily long second or expulsor portion of the seminal vesicle. Lately this species has also been recovered at autopsy from the small intestine of two native Filipinos, so that it is the fifth member of the family found naturally infecting man in the Philippines.

HAPLORCHIS VANISSIMA sp. nov. Plate 2, figs. 1 to 4.

The following description is based on the study of seven adult specimens recovered from the intestinal scrapings of an adult male Filipino, native of Bohol island, whose body was brought for autopsy to the Manila City Morgue, with a history of sudden death and with anatomic diagnosis of extensive capillary hæmorrhages in the brain. As far as could be determined, the patient had never been outside the Philippines. The material obtained was studied in the fixed and stained state.

Body ovoid or elongate, 0.375 to 0.512 mm long, 0.25 to 0.312 mm wide, covered with minute scalelike spines except at posterior extremity. Oral sucker subterminal, 0.049 mm to 0.060 mm in diameter; prepharynx short; pharynx 0.028 mm to 0.038 mm long, 0.018 to 0.035 mm wide; œsophagus 0.043 to 0.060 mm long, 0.017 mm wide; intestinal cæca extending posteriorly beyond posterior margin of testis.

Genital sac voluminous, 0.143 to 0.158 mm long, 0.105 to 0.120 mm wide, situated transversely across median field considerably beyond middle of body, pushing upward the intestinal bifurcation in most specimens. Genital sac occupied by a large oval and peculiarly ornamented gonotyl, 0.094 to 0.120 mm long, 0.087 to 0.105 mm wide. The ventrogenital sac is the most prominent structure in the fluke. Surface of gonotyl partially covered with spines, larger and more thickly set at edge and becoming smaller and rarer centripetally until they abruptly disappear completely in the central area. The spines, which vary in length from 0.0042 to 0.0085 mm, bear a striking resemblance to bamboo shoots (Plate 2, fig. 2), being septate; septa 2 or 3, the topmost conical. Legt pole of gonotyl capped with a group of small (0.0015 to 0.0054 mm in diameter), glistening, white, polygonal plates, plates 28 to 32, with pavementlike arrangement, and apparently held in position by a pair of large, clawlike, chitinous, highly refractile plates (0.033 to 0.042 mm long from tip to tip, 0.025 to 0.027 mm wide at widest point), (Plate 2, fig. 3), which lend a grotesque appearance to the fluke.

The single testis, 0.112 to 0.175 mm long, 0.070 to 0.155 mm wide, transversely oval, median in location in posterior quarter of body, somewhat removed from posterior extremity. Seminal vesicle voluminous, 0.157 mm long, 0.112 mm wide, placed on left side between testis and ventrogenital sac. Ovary oval, 0.087 mm long, 0.057 mm wide, immediately in front of testis but inclined to right side of body. Receptaculum seminis 0.054 mm long, 0.45 mm wide, placed along left side of ovary but somewhat anterior to latter. Uterine coils all behind ventrogenital sac. Vitelline glands consist of small follicles arranged in groups, all behind seminal vesicle.

Eggs 0.025 to 0.030 mm by 0.018 to 0.021 mm.

Host.—Man.

Location.—Small intestine.

Locality.—Bohol (?), Philippines.

Type specimen and paratypes in the Parasitological Collection, School of Hygiene and Public Health, University of the Philippines.

Haplorchis vanissima is easily distinguished from all known members of the genus by the extraordinarily large gonotyl and by the peculiar ornamentation of this organ, particularly the presence of a pair of large clawlike chitinous plates and the large segmented spines peripherally distributed. *H. vanissima* is the sixth member of the family found as a natural parasite in the small intestines of man in the Philippines.

HAPLORCHIS SISONI sp. nov. Plate 1, figs. 2 and 3.

In the course of experimental feedings of various laboratory animals to determine the piscine hosts of Philippine heterophyids a large number of specimens of a trematode of this group were collected from the small intestine of several pups and kittens previously fed with metacercariæ obtained from *Therapon argenteus*. On examination they were found to represent a new species of *Haplorchis*, which we have the pleasure to name after Dr. Antonio G. Sison, Director of the School of Hygiene and Public Health, University of the Philippines. The following description is based upon the examination of a large number of both fresh and mounted specimens.

Body pyriform, small, 0.336 to 0.364 mm long, 0.225 to 0.315 mm wide. Cuticle covered with small scalelike spines except at posterior half of body. Oral aperture subterminal; oral sucker 0.042 mm in diameter; prepharynx short; pharynx 0.03 mm long, 0.027 mm wide; œsophagus capillary, 0.070 to 0.075

mm long; intestinal cæca relatively short, bulky, extending posteriorly only as far as level of middle of testis.

Genital sac ringlike, median, close to and directly behind bifurcation of intestines, 0.015 mm in diameter, occupied by a small protrusible gonotyl, the surface of which is covered with extremely minute but numerous spines generally distributed within a circular area in the center which is only about 0.010 mm in diameter. At base of gonotyl inside genital sac a rudimentary acetabulum, 0.015 to 0.020 mm in diameter.

The single roughly oval testis relatively large, 0.105 to 0.122 mm long, 0.067 to 0.077 mm wide, lying transversely in median field of posterior third of body. Seminal vesicle consisting of three distinct parts located between testis and left intestine, the first portion which is thin-walled and distinctly saclike, 0.065 to 0.070 mm long, 0.030 to 0.035 mm wide, bent under second or expulsor portion from which it is separated by a short constriction. Expulsor very prominent, 0.126 to 0.135 mm long, 0.033 to 0.035 mm wide, with chitinized walls, 0.0035 to 0.0045 mm thick. Parallel transverse striations present in the inner lining. Expulsor running alongside and under left intestine medially towards ventrogenital sac, where a short likewise thick-walled ejaculatory duct which arises from it terminates in common with vagina.

Elongate ovary 0.049 mm long, 0.033 mm wide, on right side of body in front of testis but closer to ventrogenital sac. Spherical receptaculum seminis 0.060 to 0.065 mm long, 0.030 to 0.033 mm wide, between testis and ovary although more externally situated. Oviduct arising from inferior border of ovary as a short tube which unites with the one coming from the receptaculum seminis to form a common duct which proceeds to the left side of the body alongside the anterior border of the testis. Uterine coils all behind ventrogenital sac. Vitellaria consisting of small follicles arranged in groups all behind seminal vesicle.

Eggs oval with relatively prominent operculum, 0.026 mm long, 0.014 mm wide.

Hosts.—Cats and dogs, experimentally.

Location.—Small intestine.

Locality.—Manila, Philippines.

Type specimens and paratypes in the Parasitological Collection, Department of Parasitology, School of Hygiene and Public Health, University of the Philippines.

This species closely resembles *Haplorchis calderoni*, particularly in the construction of the ventrogenital sac; but whereas in

H. calderoni the expulsor may measure as long as from 0.230 to 0.350 mm, in *H. sisoni* the greatest length recorded for this organ is only 0.135 mm; and whereas the intestines in *H. calderoni* extend posteriorly beyond the posterior border of the testis, in *H. sisoni* they extend only as far posteriorly as the level of the middle of the testis. Furthermore, in *H. sisoni* the inner lining of the expulsor presents parallel transverse striations in the fresh preparation, which structure has never been noted in similar preparations of *H. calderoni.*

HAPLORCHIS TAICHUI (Nishigori, 1924) Chen, 1936.

Haplorchis taichui (Nishigori, 1924) CHEN, 1936.
Monorchotrema taichui NISHIGORI, 1924.

A careful comparison of the Philippine specimens assigned to this species with paratypes of the same kindly furnished for this study by Professors S. Yokogawa, of the Imperial University of Taihoku, Formosa, and H. T. Chen, of the Department of Biology, Lingnan University, Canton, China, has disclosed no significant differences between the Philippine and foreign specimens. Professor Chen, who has examined several mounted Philippine specimens of this species sent to him by the author, stated in a personal communication to the latter that the Philippine and the Chinese materials are identical. During the writing of this paper several specimens of *H. taichui* were received from Palestine through the courtesy of Professor Witenberg, of Hebrew University, Jerusalem, which upon comparison with the local specimens again showed no differences. On the basis of these observations it is believed that the Philippine material can be correctly assigned to *H. taichui.* In the Philippines this parasite has been recorded from man, dogs, cats, and cattle egrets as a natural infection.

HAPLORCHIS YOKOGAWAI (Katsuta, 1932) Chen, 1936.

Haplorchis yokogawai (Katsuta, 1932) CHEN, 1936.
Monorchotrema yokogawai KATSUTA, 1932.

Philippine specimens of this heterophyid were erroneously assigned by Africa and Garcia (1935) to *Monorchotrema taihokui* Nishigori, 1924, the synonymy of which with *Haplorchis pumilio* (Looss, 1899) seems to have been established by Chen (1936). Prior to the work of Chen, Witenberg (1929, 1930) pointed out that *Monorchotrema taihokui* and *Haplorchis pumilio* are identical. Prior to the appearance of Chen's paper, however, no description was available of *Haplorchis yokogawai* (*Monor-*

chotrema yokogawai) except in Japanese. Upon reading the clear description of this trematode in Chen's paper in English the present author realized that the Philippine material should have been assigned to *Haplorchis yokogawai* instead of to *H. pumilio.* This view was confirmed when the Philippine specimens were compared with paratypes of *H. yokogawai* kindly furnished the author by Professor Chen. Philippine specimens have been found identical with the Chinese material. Comparison was also made with one specimen labeled *Monorchotrema yokogawai,* furnished by Professor Yokogawa from Formosa, and the latter was also found identical with the Philippine specimens. Chen (1936) believes that the Chinese and Formosan specimens are identical. The latter author, when furnished with several mounted specimens of our local material, declared in a personal communication that these clearly belong to *H. yokogawai.* The Philippine specimens may, therefore, be correctly assigned to *Haplorchis yokogawai,* the heterophyid not only the most frequently encountered in man in this country but also the most frequently associated with cardiac failure. Moreover, this trematode has been found as a natural infection not only in man but also in dogs, cats, and cattle egrets, and has been experimentally reared not only in these latter animals but also in *Strix whiteheadi, Pyrreroidios manilensis,* and *Macacus cynomolgus.*

ACKNOWLEDGMENTS

The writer is indebted to Prof. S. Yokogawa, of Taihoku Imperial University, Taiwan (Formosa), to Prof. H. T. Chen, of the Department of Biology, Lingnan University, and to Prof. G. Witenberg, of Hebrew University, Jerusalem, for their kindness in sending specimens of *H. yokogawai* and *H. taichui* for comparison with local specimens. Thanks are also due to Drs. Vasquez-Colet and E. Y. Garcia, staff members of the Department of Parasitology, University of the Philippines, for technical assistance.

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ILLUSTRATIONS

[*ed*, Ejaculatory duct; *int*, intestine; *gtl*, gonotyl; *œs*, œsophagus; *os*, oral sucker; *ov*, ovary; *ph*, pharynx; *rac*, rudimentary acetabulum; *rs*, receptaculum seminis; *sv*, seminal vesicle; *t*, testis; *vag*, vagina; *vg*, vitelline gland; *vgs*, ventrogenital sac.]

PLATE 1

FIG. 1. *Haplorchis calderoni* (Africa and Garcia, 1935); entire worm, ventral view.

2. *Haplorchis sisoni* sp. nov.; entire worm, ventral view.

3. Microdrawing of a sagittal section of *H. sisoni;* rudimentary acetabulum.

PLATE 2

FIG. 1. *Haplorchis vanissima* sp. nov.; entire worm, ventral view.

2. Different types of spines ornamenting gonotyl of *H. vanissima.*

3. Camera lucida tracing of the ventrogenital-sac complex of *H. vanissima;* ornamentations of gonotyl.

4. Photomicrograph (h. p.) of the ventrogenital-sac complex of *H. vanissima;* spines, the two clawlike plates, and the polygonal scales in pavementlike arrangement.

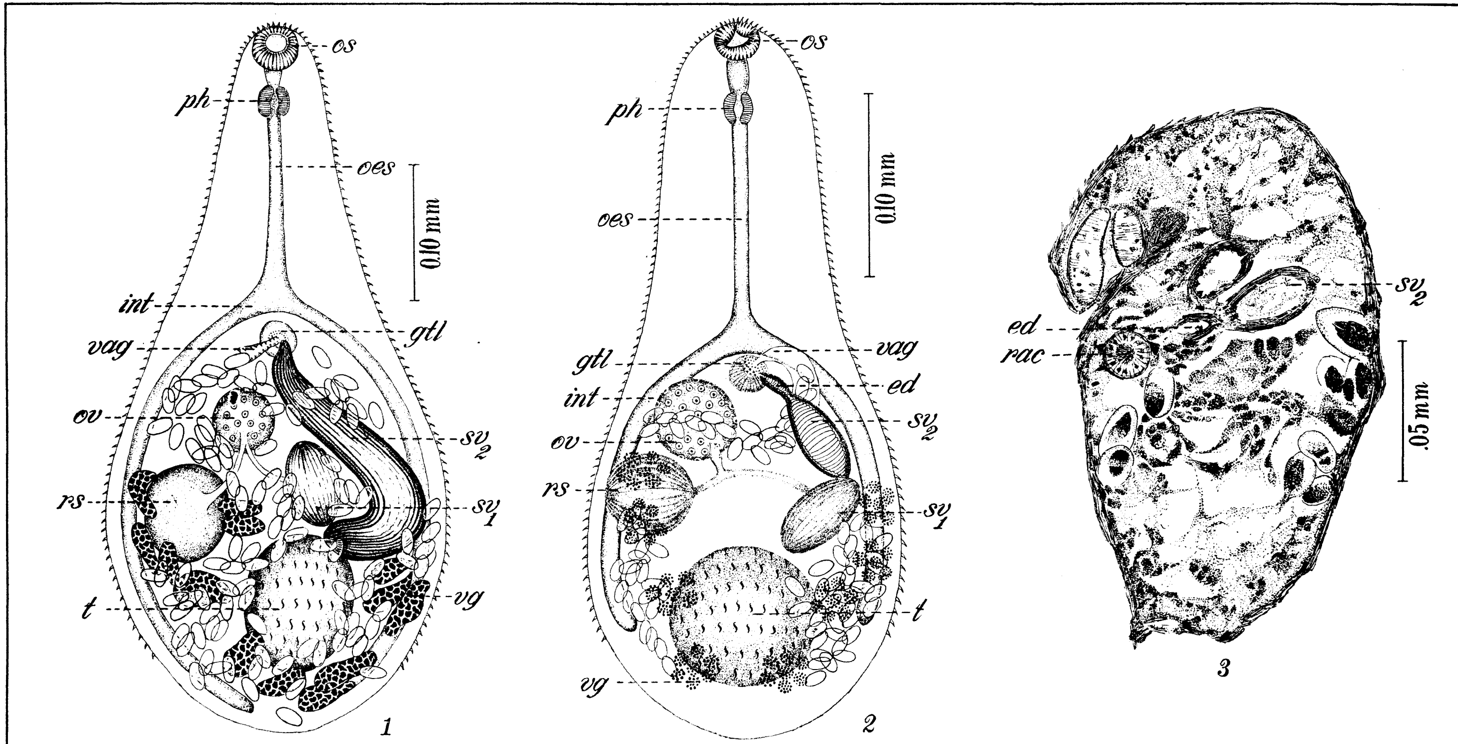
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PLATE 1.

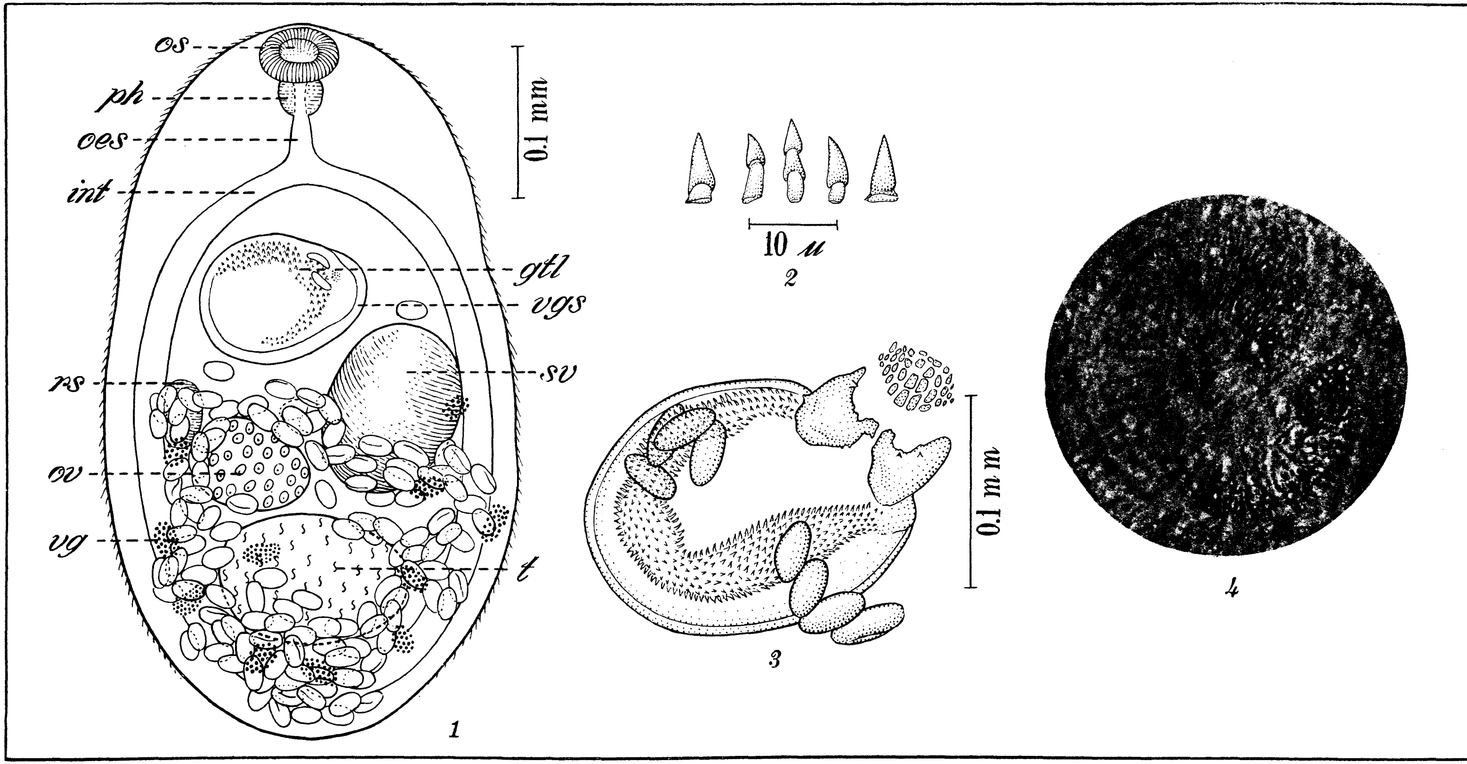

PLATE 2.

NEW OR LITTLE-KNOWN TIPULIDÆ FROM EASTERN ASIA (DIPTERA), XXXVIII [1]

By Charles P. Alexander
Of Amherst, Massachusetts

THREE PLATES

The species of crane flies described in this paper were taken in Szechwan Province, western China, by Mr. Tsen Bao-chi, native collector for the Reverend Mr. George M. Franck, who likewise secured a portion of the material. Mr. Tsen's collections were taken at various altitudes on Mount Omei between June 5 and 13, 1937, and indicate a rich and varied spring fauna as occurring on these mountains. I express my deep indebtedness to Messrs. Franck and Tsen for the opportunity of studying this interesting collection. The types of the included novelties are preserved in my extensive series of these flies. I am including a single species of the allied family Trichoceridæ.

TRICHOCERIDÆ

TRICHOCERA APPENDICULATA sp. nov. Plate 1, fig. 1; Plate 2, fig. 25.

Large (wing, male, 8 millimeters); general coloration black; halteres very long, stem yellow, knob dark; legs dark brown; wings slightly tinged with brown, with a slightly darker brown cloud on r-m; abdomen, including hypopygium, black; male hypopygium with dististyle profoundly bifid, the two arms subequal in length, the outer slenderer; from the apparent ninth sternite arises a long, depressed appendage, jutting caudad to opposite or beyond level of other structures of hypopygium.

Male.—Length, about 7 millimeters; wing, 8.

Rostrum and palpi black. Antennæ brownish black throughout, moderately long, if bent backward extending to some distance beyond base of abdomen. Head black.

Thorax uniformly blackened. Halteres remarkably long and slender, if bent backward extending to nearly opposite outer end of second abdominal segment; stem yellow, knob small, brownish black. Legs dark brown. Wings (Plate 1, fig. 1)

[1] Contribution from the entomological laboratory, Massachusetts State College.

with a slight brown suffusion; a vague, slightly darker brown cloud on r-m; veins pale brown. Macrotrichia of veins relatively short. Venation: Sc_2 shortly before midlength of Rs; basal section of R_5 very short, r-m correspondingly lengthened; petiole of cell M_1 a little shorter than second section of vein M_{1+2}.

Abdomen, including hypopygium, black. Male hypopygium with dististyle (Plate 2, fig. 25, *d*) profoundly bifid at near midlength; stem stout, outer arm much slenderer, its outer surface with scattered coarse setæ, inner or mesal face with long delicate setæ; inner arm or lobe about equal in length to outer, more flattened, especially at near midlength, apex gradually narrowed into a slender point, extreme tip curved; distal half of arm pale, lower margin with a series of 15 to 18 small setæ. Gonapophyses of moderate length. From what appears to be the ninth sternite, but which cannot be definitely recognized from the unique slide type, projects a depressed, dark-colored lobe, narrower at base, gently widened outwardly, median area further produced into a narrower lobe that is densely provided with coarse black setæ; lateral shoulders of appendage with very long coarse setæ that jut caudad to beyond level of median lobe.

Habitat.—China (Szechwan).

Holotype, male, Kwanhsien, altitude 3,500 feet, December, 1936 (*Franck*).

Trichocera appendiculata is very distinct from all described members of the genus. The remarkable structure, apparently borne by the last abdominal sternite, is unique among the species so far described.

TIPULIDÆ

TIPULINÆ

TANYPTERA ANTICA sp. nov. Plate 1, fig. 2.

Small (wing, male, under 10 millimeters); general coloration black, thorax and first abdominal tergite roughened alutaceous; halteres yellow throughout; legs reddish, fore tibiæ with a broad white ring before tips; wings strongly suffused with brown, base more yellowish; stigma subcircular, darker brown; cell 1st M_2 small, pentagonal; abdominal tergites broadly black medially, reddish yellow on sides.

Male.—Length, about 12 millimeters; wing, 9.5; antennæ, about 4.

Frontal prolongation of head black, with dense yellow setæ; palpi pale brown, outer segments darker. Antennæ black, pedicel reddish brown; antennæ moderately long, if bent backward extending about to halteres; basal flagellar branches moderately long, longest (about flagellar segment seven or eight) about one and one-half as long as segment; unpaired branch about one-half length of paired branches. Head black, subnitidous.

Thoracic dorsum black, surface only faintly nitidous, interspaces with conspicuous yellow setæ; surface of usual præscutal stripes faintly alutaceous; scutellum and postnotum more conspicuously roughened. Pleura and pleurotergite dull black, surface conspicuously roughened, alutaceous. Halteres pale yellow. Legs with coxæ dull black, with a dense white pubescence; trochanters pale yellow; fore femora reddish brown, narrowly yellow at base; fore tibiæ brownish black, with a broad white ring before narrow darkened tip, this ring occupying about one-third total length of tibia; fore tarsi passing through dark brown to black; middle and posterior femora reddish, tibiæ and tarsi more obscure yellow, terminal segments infuscated. Wings (Plate 1, fig. 2) with a strong brown suffusion, prearcular field, cells Sc and Cu_1, and base of cell 2d A, more yellowish; stigma subcircular, darker brown; a weak dark cloud on anterior cord; pale obliterative areas before stigma, across end of Rs and involving base of cell 1st M_2; veins dark brown, more yellowish in brightened areas. Venation: Tips of Sc_1 and free tip of Sc_2 atrophied; R_{1+2} entire, suberect; Rs short, arcuated; veins of outer radial field short; cell M_1 about three times its petiole, latter longer than m; cell 1st M_2 small, pentagonal; vein M_4 bent strongly backward, so cell M_3 at margin considerably wider than cell M_3.

Basal abdominal tergite dull black, alutaceous; succeeding tergites broadly black medially, reddish yellow on sides, subterminal segments and hypopygium black; sternites reddish yellow.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, Chu Lao Tong Temple, altitude 6,500 feet, June 12, 1937 (*Tsen*).

Tanyptera antica is readily told from other small species in eastern Asia, such as *T. angustistyla* Alexander, by the dull alutaceous surface of the thorax and basal abdominal tergite, the broad white ring on the fore tibia, yellow halteres, and details of venation, as the entire R_{1+2}.

DICTENIDIA GLABRATA sp. nov. Plate 1, fig. 3.

General coloration polished yellow, præscutum and scutal lobes chiefly polished black; antennal flagellum brownish black; pronotum and pleura yellow; posterior legs not conspicuously enlarged or hairy; tibiæ black, with a narrow white ring near base; wings faintly yellow, sparsely patterned with brown, including tip and a complete but narrow band at cord; cells of wing without macrotrichia; abdominal tergites brownish yellow, trivittate with black; basal sternites with a median black stripe.

Female.—Length, about 16 millimeters; wing, 12.

Frontal prolongation of head brownish yellow, nasus conspicuous; palpi with basal segment brown, remainder black. Antennæ (female) apparently 11-segmented, outer flagellar segments short, crowded, more or less consolidated; scape and pedicel pale yellow, flagellum uniformly brownish black. Front yellow, broad anterior vertex polished black; genæ and occiput obscure yellow.

Pronotum uniformly yellow. Mesonotal præscutum almost covered by three polished black stripes, restricting ground color to narrow obscure yellow intermediate lines; scutal lobes similarly blackened, median area, together with posterior sclerites of notum, obscure polished yellow. Pleura, including dorsopleural membrane and pleurotergite, yellow. Halteres with stem and base of knob dusky, apex of knob yellow. Legs with coxæ and trochanters yellow; fore and middle femora almost uniformly obscure brownish yellow, apex scarcely darker; tibiæ brown, tips brownish black; tarsi black; posterior legs longer and more powerful than the others but not so markedly so as in *D. formosana*, *D. pictipennis*, and *D. luteicostalis* among the species in eastern Asia; legs not conspicuously hairy; posterior femora obscure yellow, tips narrowly but conspicuously blackened, preceded by a similarly narrow, clearer yellow ring; tibiæ black with a narrow white ring placed a little more than its own length beyond base; tarsi black. Wings (Plate 1, fig. 3) with a faint yellow tinge, prearcular and costal portions deeper yellow; a restricted brown pattern, as follows: A narrow band at cord, completely traversing wing from stigma to posterior margin; wing tip narrowly darkened, involving cells R_2 to M_1, inclusive; a linear brown streak in center of cell R, more widened in basal portion, extending beyond origin of Rs which is likewise slightly clouded; veins black, including those in brighter costal

portion. Cells of wing without macrotrichia, as in *inæquipectinata*. Venation: Rs more than twice m-cu; petiole of cell M_1 subequal to m.

Abdominal tergites obscure brownish yellow, beyond first segment with three narrow black stripes, median broader than laterals; extreme caudal borders on either side of median stripe clearer yellow; sternites brownish yellow, basal and intermediate segments blackened medially; subterminal segments and genital shield polished black; cerci horn-yellow.

Habitat.—China (Szechwan).

Holotype, female, Mount Omei, altitude 5,000 feet, June 5, 1937 (*Tsen*).

The only described species of *Dictenidia* without macrotrichia in the outer cells of wing is *D. inæquipectinata* Alexander, of the high mountains of Formosa. In its wing pattern the present fly is most like the genotype, *D. bimaculata* (Linnæus), of the northern Palæarctic region, which differs from *glabrata* in the apically pilose wings and in the very different leg pattern. The latter character is much like that of many species of *Pselliophora* Osten Sacken, but the present fly is a true *Dictenidia*. In an earlier report under this general title,[2] I have indicated the increasing difficulties in the generic separation of the females of the Ctenophoraria.

Since the above was written, a male specimen has come to hand that I believe represents this sex of the present fly. It differs from the description given, as follows:

Head above yellow, with a transverse band across the anterior vertex, this marking trilobed across anterior border. Antennæ (male) with branches elongate, distal branch a little slenderer than basal branch and ranging from two-thirds to three-fourths as long. Præscutum with three separate black stripes, laterals crossing suture and covering centers of scutal lobes. Wings unmarked except for the brownish black stigma, a broad brown seam on anterior cord, and a narrower brown seam on m-cu. Petiole of cell M_1 shorter than m. Abdominal tergites trivittate, the median stripe narrower on cephalic portion; fifth and succeeding segments uniformly blackened.

Allotype, male, Pehlüting (White Deer Mountain), altitude 6,000 feet, July 11, 1937 (*Franck*).

[2] Philip. Journ. Sci. 60 (1936) 167, 168.

LIMONIINÆ

LIMONIINI

LIMONIA (LIMONIA) IMPROVISA Alexander.

Limonia (*Limonia*) *improvisa* ALEXANDER, Philip. Journ. Sci. 51 (1933) 535, 536.

The types were taken from the China-Tibet border at high altitudes. One male, White Cloud Temple, Mount Omei, altitude 9,000 feet, June 12, 1937 (*Tsen*). This specimen is larger than the types (male, length, about 11 millimeters; wing, 14) with the wing pattern heavier, especially the major dark areas at cord, origin of Rs, and beyond the arculus.

LIMONIA (LIMONIA) PERBEATA sp. nov. Plate 1, fig. 4; Plate 2, fig. 26.

General coloration of thorax uniformly polished black; antennæ black, outer flagellar segments progressively lengthened; halteres elongate, knobs very weakly darkened; legs with fore coxæ black, remaining coxæ and all trochanters yellow; fore femora with outer end extensively blackened, posterior femora with tips narrowly so; tibiæ obscure yellow; wings yellowish subhyaline, with a restricted brown pattern, including all of cell C; vein Sc short, Rs spurred at origin; male hypopygium with dististyle produced into a long yellow beak; gonapophyses with mesal-apical lobes dark brown, broad; ædeagus terminating in two divergent points.

Male.—Length, about 6.5 millimeters; wing, 8.

Rostrum and palpi black. Antennæ black throughout; basal flagellar segments short-oval, with short apical necks; outer segments becoming more elongate, last about one and one-half as long as penultimate; verticils of outer segments subequal in length to segments themselves. Head dark gray; anterior vertex narrow, about two-thirds diameter of scape.

Thorax uniformly polished black. Halteres elongate, pale yellow, knobs very weakly darkened. Legs with fore coxæ brownish black, remaining coxæ light yellow; trochanters yellow; femora yellow basally, tips blackened, very broadly so on forelegs where only about proximal fourth is yellow; posterior femora yellow, with about distal ninth darkened; remainder of legs obscure yellow, outer tarsal segments passing into brownish black; claws with a single slender basal spine, about one-third as long as claw itself. Wings (Plate 1, fig. 4) yellowish subhyaline, restrictedly patterned with brown; cell C uniformly darkened, cell Sc darkened on basal half; brown seams at fork

of Sc, origin of Rs, R_2, cord, and outer end of cell 1st M_2; veins brownish yellow, somewhat darker in clouded areas, paler at wing base. Venation: Sc short, Sc_1 ending about opposite one-third length of Rs, Sc_2 at its tip; Rs angulated and spurred at origin, spur nearly as long as basal section of Rs; free tip of Sc_2 nearly three times R_2; m-cu at fork of M.

Abdomen, including hypopygium, dark brown. Male hypopygium (Plate 2, fig. 26) with tergite, *9t*, transverse, caudal margin straight. Dististyle, *d*, with body small, subequal to ventromesal lobe of basistyle, beak long-produced, yellow beyond base. Gonapophyses, *g*, with mesal-apical lobes darkened, broad, outer margin weakly roughened, apical spine short. Ædeagus, *a*, pale, at apex produced into two divergent points, surface with numerous microscopic spines that are directed outwardly.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, White Cloud Temple, altitude 9,000 feet, June 12, 1937 (*Tsen*).

In general appearance similar to *Limonia* (*Limonia*) *anthracina* (Alexander) but entirely distinct, being most nearly allied to the almost uniformly yellow species *L.* (*L.*) *omniflava* Alexander, likewise from western China. In the black body coloration and restrictedly patterned wings the present fly bears a noteworthy superficial resemblance to *Limonia* (*Dicranomyia*) *lethe* sp. nov., *Limnophila* (*Prionolabis*) *carbonis* sp. nov., and *Elephantomyia* (*Elephantomyia*) *carbo* sp. nov., all from Mount Omei.

LIMONIA (DICRANOMYIA) TSENI sp. nov. Plate 1, fig. 5; Plate 2, fig. 27.

General coloration of mesonotum brownish yellow, pollinose; pronotum and cephalic half of præscutum with a narrow brownish black median stripe; femora yellow, tips narrowly brownish black; wings grayish subhyaline, stigma pale brown, inconspicuous; male hypopygium with caudal margin of tergite bearing a bilobed plate; basistyle with ventromesal lobe large, complicated by outgrowths and brushes; dorsal dististyle suddenly narrowed at tip; ventral dististyle with rostral region bifid; base of rostral prolongation with a slender arm, tipped with setæ.

Male.—Length, 7.5 to 8.5 millimeters; wing, 8.2 to 9.5.

Rostrum brown; palpi black. Antennæ with scape and pedicel black, flagellum brown; flagellar segments oval, terminal segment slightly longer than penultimate. Head blackish, sparsely pruinose.

Pronotum dark brown medially, yellow on sides. Mesonotum brownish yellow, pollinose, præscutum with a narrow brownish black median stripe that becomes obsolete at near midlength of sclerite. Pleura brownish yellow, pollinose. Halteres elongate, stem pale, knob dark brown. Legs with coxæ and trochanters yellow; femora yellow, tips rather narrowly brownish black, the amount subequal on all legs; tibiæ brownish yellow, tips very narrowly darkened; tarsi black; claws with a single long basal spine. Wings (Plate 1, fig. 5) faintly grayish subhyaline; stigma pale brown, inconspicuous; veins brown. Venation: Sc_1 ending shortly beyond origin of Rs, Sc_2 a little removed from its tip; Rs more than twice basal section of R_{4+5}; m-cu just beyond fork of M.

Abdominal tergites dark brown, sternites paler; hypopygium chiefly dark, ventral dististyle pale. Male hypopygium (Plate 2, fig. 27) very complex in structure, especially basistyle, *b*, and ventral dististyle, *vd*, general structure somewhat as in *grahamiana* but with the details quite distinct. Ninth tergite, *9t*, broadly transverse, caudal margin bearing a median projection that divides into two divergent lobes, separated by a narrow incision. Basistyle, *b*, with ventromesal lobe very broad and flattened, in the axil bearing a long pale lobe tipped with numerous setæ and flattened spines, with other hair brushes at base. Dorsal dististyle a gently curved rod, abruptly narrowed at apex into a straight spine. Ventral dististyle, *vd*, of moderate size, pale, fleshy; rostral prolongation stout, bifid, outer arm slender, tufted with setæ; lower arm truncated at apex, with a few setæ, including two stouter pendant setæ; rostral spines two, of moderate size, placed close together on face of rostrum at near midlength. From base of style, cephalad of prolongation, with a slender sclerotized arm, tipped with setæ. Gonapophyses, *g*, with mesal-apical lobe relatively slender, smooth.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, White Cloud Temple, altitude 9,000 feet, June 12, 1937 (*Tsen*). Paratopotype, male, June 5, 1937.

The nearest described ally of the present fly is *Limonia (Dicranomyia) grahamiana* Alexander, of western China and Tibet, which differs in details of coloration, as the conspicuous wing stigma, and in the structure of the male hypopygium, especially the tergite and dististyles.

LIMONIA (DICRANOMYIA) LETHE sp. nov. Plate 1, fig. 6; Plate 2, fig. 28.

General coloration polished black; femora yellow, tips brownish black; wings yellow, costal and prearcular portions clearer yellow; a sparse dark pattern, including seams on cord, outer end of cell 1st M_2 and along vein Cu; Sc_1 terminating a short distance beyond origin of Rs; male hypopygium with a single rostral spine.

Male.—Length, 6.8 to 7 millimeters; wing, 7.2 to 7.5.

Female,—Length, about 8 millimeters; wing, 8.5.

Rostrum and palpi black. Antennæ with scape brown; pedicel obscure yellow; flagellum black. Head blackish gray; anterior vertex narrow, about one-half diameter of scape.

Thorax polished black throughout. Halteres pale yellow. Legs with fore and middle coxæ blackened, apex of latter pale, posterior coxæ yellow; trochanters yellow; femora yellow, tips brownish black, moderately wide and subequal on all legs; tibiæ obscure yellow, tips very narrowly darkened; basitarsi obscure yellow, remaining segments brown. Wings (Plate 1, fig. 6) yellow, costal and prearcular portions clearer yellow; a restricted brown pattern, including oval stigma, very narrow seams along cord and outer end of cell 1st M_2, and a wider seam on central portion of vein Cu in cell M; veins beyond cord and all of Cu except for base brown, remaining veins light yellow. Venation: Sc long for a member of the subgenus, Sc_1 ending about opposite one-sixth length of Rs, Sc_2 at tip; free tip of Sc_2 and R_2 in transverse alignment; cell 1st M_2 shorter than veins beyond it; m-cu at fork of M.

Abdomen, including hypopygium, black. Male hypopygium (Plate 2, fig. 28) with caudal margin of tergite, *9t,* with a deep V-shaped notch, lobes obtusely rounded. Dorsal dististyle sickle-shaped. Ventral dististyle, *vd,* small, its extent less than that of basistyle, subcircular to short-oval in outline; rostral prolongation powerful, beyond rostral spine narrowed and terminating in an acute blackened point; rostral spine single, from a scarcely developed tubercle, subequal in length to prolongation itself. Gonapophyses, *g,* with mesal-apical lobe slender, blackened. Ædeagus, *a,* relatively narrow.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, Chu Lao Tong Temple, altitude 6,500 feet, June 6, 1937 (*Tsen*). Allotopotype, female. Paratopotype, male.

In its general appearance, especially the polished black color of the thorax, and in the structure of the male hypopygium, as the single rostral spine of the ventral dististyle, the present fly suggests members of the *morio* group, but I am not entirely convinced that it belongs there. It is very distinct from all described regional species of *Dicranomyia*, especially in the unusually long Sc, wing pattern, and structure of the male hypopygium.

ANTOCHA (ANTOCHA) FLAVIDIBASIS sp. nov. Plate 1, fig. 7.

General coloration light gray, præscutum with four stripes that are confluent or nearly so; antennæ black throughout; halteres with dark-brown knobs; femora brown, tibiæ and tarsi brownish black; wings pale gray, prearcular field conspicuously light yellow; stigma not or scarcely indicated; abdominal tergites dull black, sternites more grayish.

Female.—Length, about 8.5 millimeters; wing, 9.

Rostrum brown; palpi black. Antennæ black throughout; flagellar segments oval, outer segments more elongate. Head brown, front and anterior vertex, together with narrow posterior orbits, light gray, the two colors separated by a narrow darker line.

Pronotum and mesonotum light gray, disc of præscutum chiefly covered by four confluent or virtually confluent stripes; scutal lobes similarly darkened. Pleura gray. Halteres yellow, knobs dark brown. Legs with coxæ gray; trochanters black; femora brown, tibiæ and tarsi brownish black. Wings (Plate 1, fig. 7) tinged with pale gray, prearcular region clear light yellow, conspicuous; stigma not or scarcely differentiated against ground; veins pale brownish yellow, clear luteous in prearcular field. Venation: R_2 in transverse alignment with r-m; m-cu about one-fourth its length before fork of M.

Abdominal tergites dull black, sternites more grayish; genital shield blackened; cerci horn-colored, short but strong.

Habitat.—China (Szechwan).

Holotype, female, Mount Omei, White Cloud Temple, altitude 9,000 feet, June 12, 1937 (*Tsen*).

Antocha (*Antocha*) *flavidibasis* is one of the largest species so far discovered. It is equal in size to *A.* (*A.*) *nebulipennis* Alexander, likewise from western China and the Tibet border, differing in the clear wings, without pattern, and with the base abruptly light yellow. The black antennæ, dark legs, and pale wing veins furnish additional characters that separate the fly from near relatives.

ANTOCHA (ANTOCHA) NEBULIPENNIS IMMACULATA subsp. nov. Plate 2, fig. 29.

Male.—Length, about 6 millimeters; wing, 7.

Differs from the typical form in the small size, unpatterned wings, and details of structure of the male hypopygium.

Antennæ (male) with scape obscure yellow, remaining segments black; flagellar segments oval, clearly delimited; antennæ relatively long, if bent backward ending a short distance before wing root. Mesonotum light gray, with three pale-brown stripes, broad median stripe very vaguely and indistinctly divided by a pale vitta. Halteres with stem obscure yellow, knob dark brown. Legs black. Wings whitish subhyaline, prearcular field yellow; stigma very small, indistinct; veins dark, vaguely bordered with darker, vein C paler. Venation: Rs very long, approximately three times R alone; cell 1st M_2 narrow; m-cu about one-third its length before fork of M.

Abdomen dark brown, pruinose; hypopygium dark. Male hypopygium (Plate 2, fig. 29) with the tergite, *9t*, conspicuously bilobed, contour of lobes about same as that of median notch. Apex of basistyle, *b*, only moderately produced. Outer dististyle, *od*, blackened, apex narrowed but not abruptly so, as in typical form. Gonapophyses appearing as straight acicular spines.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, White Cloud Temple, altitude 9,000 feet, June 12, 1937 (*Tsen*).

The present fly is told from *Antocha* (*Antocha*) *flavidibasis* sp. nov. by the nature of the thoracic pattern and the darkened wing veins that contrast markedly with the ground.

PEDICIINI

DICRANOTA (RHAPHIDOLABIS) PRÆCISA sp. nov. Plate 1, fig. 8; Plate 2, fig. 30.

General coloration gray, præscutum with four darker brown stripes; halteres dark brown, base of stem yellow; legs dark brown; wings subhyaline, ill-defined stigma pale brown; Rs weakly to strongly angulated at near midlength; R_2 oblique, close to tip of R_1; male hypopygium with caudal margin of tergite bearing two slender lobes; interbase a flattened plate with serrated margin; basistyle terminating in two lobes; dististyle a flattened mitten-shaped plate.

Male.—Length, about 6 millimeters; wing, 7.2.

Female.—Length, 7 to 7.5 millimeters; wing, 7.5 to 8.5.

Rostrum dark gray; palpi black. Antennæ black throughout, 15-segmented; flagellar segments beyond elongate basal segment oval. Head dark gray.

Mesonotum dark gray pruinose, with four darker brown stripes, intermediate pair very narrowly separated by a pale vitta; scutal lobes darkened. Pleura gray. Halteres dark brown, stem yellow basally. Legs with coxæ darkened; remainder of legs dark brown, femoral bases restrictedly paler. Wings (Plate 1, fig. 8) subhyaline, ill-defined stigma pale brown; veins pale brown. Venation: Rs weakly to strongly angulated at near midlength; R_2 oblique, close to tip of R_1; cell M_1 variable in length, from about one-third to approximately two-thirds as long as cell M_3.

Abdomen dull black, pruinose; hypopygium brownish yellow. Male hypopygium (Plate 2, fig. 30) with the tergite, *9t*, produced into two slender parallel lobes, each clothed at apex and on lateral face with long setæ; median area of caudal margin between lobes produced into a very low triangular glabrous point. Basistyle, *b*, with interbase, *i*, a flattened plate, widest at near midlength, inner edge with a series of about a dozen retrorse teeth, beginning at apex, largest just beyond midlength of plate, becoming smaller toward base, last merely crenulate; outer margin before apex with four or five similar erect teeth. Basistyle, *b*, with two apical lobes that are provided with short spinous setæ. Dististyle, *d*, single, appearing as a flattened, mitten-shaped plate, with several coarse marginal setæ and fewer smaller punctures scattered over disc.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, White Cloud Temple, altitude 9,000 feet, June 12, 1937 (*Tsen*). Allotopotype, female. Paratopotypes, 2 females.

The nearest relative is *Dicranota* (*Rhaphidolabis*) *biloba* Alexander, likewise from western China, including Mount Omei, which differs conspicuously in the structure of the male hypopygium.

DICRANOTA (AMALOPINA) SIMPLEX sp. nov. Plate 1, fig. 9; Plate 2, fig. 31.

Belongs to the *flaveola* group; general coloration whitish, including legs, halteres, and antennæ; wings whitish, with a very restricted dark pattern that involves only veins; no supernumerary crossvein in cell R_1; cell 1st M_2 closed; terminal abdominal segments (male) darkened; interbase of hypopygium dilated at apex into a compressed blade.

Male.—Length, 5.5 to 6 millimeters; wing, 6.5 to 7.

Female.—Length, about 6 to 6.5 millimeters; wing, 7 to 7.5.

Rostrum and palpi white. Antennæ white throughout, short, if bent backward not quite reaching wing root. Head whitish.

Thorax uniformly pinkish white or yellowish white, sparsely dusted with white. Halteres white. Legs white, femoral tips in cases vaguely a little darker; terminal tarsal segments darkened. Wings (Plate 1, fig. 9) whitish; veins pale, variegated by very restricted darkened areas that are confined to actual veins, including h; arculus; origin of Rs; Sc_2; cord; fork of R_{2+3+4}; R_2, and outer end of cell 1st M_2. Venation: No supernumerary crossvein in cell R_1; cell 1st M_2 closed.

Abdomen pale, brownish white; hypopygium and subterminal segment brown. Male hypopygium (Plate 2, fig. 31) with general conformation much as in *dicranotoides*. Dististyle, *d*, long, slender, with setæ of various lengths at and near tip. Lateral tergal arms, *9t*, appearing as slender sinuous rods, tips narrowly obtuse. Interbase, *i*, much shorter, tips expanded into compressed blades.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, White Cloud Temple, altitude 9,000 feet, June 12, 1937 (*Tsen*). Allotopotype, female, June 5, 1937. Paratopotypes, several males and females, June 5 and 12, 1937.

By my key to the Japanese species of *Amalopina* [3] the present fly runs to *D.* (*A.*) *fumicosta* Alexander, of Formosa, a very different fly. In its general appearance the new species is most like *D.* (*A.*) *dicranotoides* (Alexander) which is readily distinguished by the presence of a supernumerary crossvein in cell R_1 of the wings.

DICRANOTA (AMALOPINA) HYALIPENNIS sp. nov. Plate 1, fig. 10.

Belongs to the *elegantula* group; thorax uniformly pale whitish; fore and middle femora black, remainder of legs whitened; wings hyaline, unmarked except for a darkening of veins comprising cord and origin of Rs; Sc_2 shortly before origin of the long Rs, latter subequal to R; R_2 transverse, longer than R_{1+2}.

Sex ?—Wing 6 millimeters.

Rostrum brown; palpi black. Antennæ broken. Front and anterior vertex darkened, pruinose; occiput yellow.

Thorax uniformly pale whitish or pinkish white. Halteres with stem pale, knob broken. Legs with all coxæ and trochanters pale yellow; fore and middle femora black, remainder of

[3] Philip. Journ. Sci. 56 (1935) 358, 359.

legs white, only terminal tarsal segments a trifle infumed. Wings (Plate 1, fig. 10) hyaline, unmarked except for slightly infuscated origin of Rs and cord, remaining veins pale yellow. Venation: Sc_2 a distance before origin of Rs about equal to three times its own length; Rs long, arcuated at origin, subequal to vein R; R_2 transverse, longer than R_{1+2}; R_{2+3+4} about twice basal section of R_5; outer medial forks relatively deep; m-cu about one-third its length beyond fork of M.

Abdomen broken.

Habitat.—China (Szechwan).

Holotype, Sex?, Mount Omei, Chu Lao Tong Temple, altitude 6,500 feet, June 6, 1937 (*Tsen*).

Dicranota (*Amalopina*) *hyalipennis* is readily separated from all previously described members of the *elegantula* group by the nearly hyaline wings, with distinct venational details. The known species of this group may be separated as follows:

Key to the known species of the elegantula group.

1. Mesonotum distinctly patterned, with a dark median præscutal stripe and paired dark stripes from suture caudad, leaving centers of scutum, scutellum, and mediotergite pale .... 2.
   Mesonotum uniformly pale. .... 4.
2. Wings nearly clear (Eastern Himalayas to Malay Peninsula). *D.* (*A.*) *elegantula* (Brunetti).
   Wings distinctly patterned with brown, including a marginal series of spots at ends of longitudinal veins. (*gibbera* group) .... 3.
3. Wings (male) broad, widest opposite end of vein 2d A (Japan). *D.* (*A.*) *gibbera gibbera* (Alexander).
   Wings (male) narrow, of approximately equal width along central third of wing (northern Japan). *D.* (*A.*) *gibbera karafutonis* (Alexander).
4. Wing markings greatly reduced, restricted to veins comprising origin of Rs and cord; Rs subequal to vein R before Sc_2 (western China). *D.* (*A.*) *hyalipennis* sp. nov.
   Wings with a large darkened area at cord, reaching costa anteriorly; all longitudinal veins with small darkened marginal spots; Rs nearly twice as long as vein R before Sc_2 (western China). *D.* (*A.*) *megaplagiata* Alexander.

All species of the *elegantula* group have the legs pale with exception of the femora of the fore and middle legs, which are abruptly and uniformly blackened.

HEXATOMINI

OXYDISCUS (OXYDISCUS) REDUCTUS sp. nov. Plate 1, fig. 11; Plate 2, fig. 32.

General coloration of mesonotum and pleural almost uniformly dark brown; halteres infuscated; femora yellow, tips abruptly

blackened; wings weakly infuscated, prearcular and broad costal portion light cream-yellow; a restricted but clearly defined brown pattern; macrotrichia of cells reduced in number; R_2 some distance before fork of R_{3+4}; cell M_1 present, about one-half its petiole; m-cu at near midlength of cell 1st M_2; male hypopygium with styli terminal in position.

Male.—Length, about 4.5 millimeters; wing, 5.

Rostrum testaceous yellow; palpi black. Antennæ brownish black throughout, 16-segmented; beyond basal three or four, flagellar segments becoming elongate, almost setaceous; verticils exceeding segments in length. Head brown.

Mesonotum almost uniformly dark brown, surface polished, lateral portions of præscutum and scutum a little paler. Pleura almost uniformly dark brown. Halteres infuscated, base of stem narrowly yellow. Legs with coxæ yellowish testaceous; trochanters yellow; femora yellow, tips rather narrowly and abruptly blackened, amount subequal on all legs; tibiæ and basitarsi yellow, extreme tips very narrowly and insensibly darkened; outer tarsal segments infuscated. Wings (Plate 1, fig. 11) with ground color weakly infuscated, prearcular and broad costal portions light cream-yellow; anal cells a little paler than ground; a restricted but very distinct brown pattern, arranged as follows: Arculus, origin of Rs, stigma, cord, outer end of cell 1st M_2 and fork of R_{3+4}; veins pale brown, more flavous in brightened areas. Wings widened opposite termination of vein 2d A, this presumably a sexual character. Macrotrichia of cells reduced in number when compared with *issikina*, restricted to outer portions of outer radial and medial cells and in the stigmal darkening (shown in figure by stippling). Venation: Sc_1 ending shortly before fork of Rs, Sc_2 slightly removed from its tip; Rs weakly angulated at origin; R_2 some distance before fork of R_{3+4}; cell M_1 about one-half its petiole; m-cu at near midlength of cell 1st M_2; vein and cell 2d A elongate (at least in male).

Abdomen dark brown, lateral borders narrowly more blackened; hypopygium dark. Male hypopygium (Plate 2, fig. 32) with styli terminal, basistyle not produced at apex. Outer dististyle, *od*, uniformly blackened, apex unequally bispinous, lower spine longer and more curved; on mesal margin before apex with a broadly triangular point.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, Flying Bridges Temple, altitude 2,800 feet, June 11, 1937 (*Tsen*).

Oxydiscus (*Oxydiscus*) *reductus* is most nearly allied to *O.* (*O.*) *issikina* (Alexander), of Formosa, which, while generally similar in coloration, has the macrotrichia of the wing cells much more extensive, including the cells beyond the cord and involving the outer end of cell R. It should be noted here that the name *Adelphomyia* as formerly interpreted will have to be replaced by *Oxydiscus* de Meijere. Edwards has examined the holotype specimen of the genotype of *Adelphomyia, A. helvetica* Bergroth, and finds it to be a synonym of *Limnophila punctum* (Meigen). As a consequence, *Tricholimnophila* Alexander will fall as a synonym of *Adelphomyia* Bergroth (in the genus *Limnophila* Macquart) while *Oxydiscus* will become the valid name for the group under consideration.

EPIPHRAGMA (EPIPHRAGMA) SULTANA sp. nov. Plate 1, fig. 12; Plate 2, fig. 33.

General coloration grayish pruinose; antennæ (male) relatively elongate; basal two flagellar segments fused, orange, remaining segments black; halteres long, pale brown; femora chiefly blackened, bases narrowly yellow; a narrow yellow subterminal ring; tibiæ and tarsi darkened; stigma darkened; basal abdominal tergites reddish brown, trivittate with darker, outer segments and hypopygium more uniformly darkened; male hypopygium with interbase elongate.

Male.—Length, 11 to 12 millimeters; wing, 12 to 13; antennæ, 3.9 to 4.

Female.—Length, about 11.5 to 13 millimeters; wing, 12 to 13.

Rostrum grayish black; palpi black. Antennæ (male) relatively elongate, as shown by measurements; scape and pedicel black; basal flagellar segment orange, succeeding segments black; flagellar segments cylindrical, with verticils that are shorter than the segments; basal flagellar segment evidently resulting from the partial fusion of two segments, the antennæ being 15-segmented; terminal segment about one-half as long as penultimate. Head dark gray, center of vertex and occiput more reddish, more or less variegated with brown.

Mesonotum chiefly gray to yellowish gray pruinose, variegated with brown, including humeral region, lateral præscutal border and four narrow stripes on posterior third of præscutum; scutal lobes darkened. Pleura gray, variegated with more blackish areas, including an irregular longitudinal stripe and the ventral sternopleurite. Halteres relatively elongate, pale brown. Legs with coxæ brownish yellow; trochanters obscure yellow; femora chiefly blackened, bases narrowly yellow, with a narrow yellow

subterminal ring; extreme femoral tips more or less brightened; remainder of legs dark brown to brownish black, tarsi more or less brightened by yellow pubescence. Wings (Plate 1, fig. 12) with ground color pale yellow, variegated by the usual pale-brown pattern of the genus, dark areas narrowly bordered by still darker brown; pattern intricate, with all markings more or less interconnected; stigma solidly dark brown, occupying both sides of vein R_2; veins brownish yellow, darker in the patterned areas. Venation: Supernumerary crossvein in cell C transverse; R_{2+3+4} subequal to or a little longer than R_{2+3}; cell 1st M_2 large, with m-cu shortly before midlength.

Basal abdominal tergites reddish brown, trivittate with darker, on outer segments ground color more uniformly darkened; caudal borders of segments narrowly light gray; hypopygium yellow; basal sternites more uniformly yellow, narrowly bordered posteriorly with gray, outer sternites more uniformly pruinose; hypopygium black. Male hypopygium (Plate 2, fig. 33) with the interbase, *i*, very long and slender, exceeding length of basistyle.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, White Cloud Temple, altitude 9,000 feet, June 12, 1937 (*Tsen*). Allotype, female, Mount Omei, summit, altitude 11,000 feet, June 9, 1937 (*Tsen*). Paratopotypes, males and females, with the types, June 5 and 12, 1937.

Epiphragma (*Epiphragma*) *sultana* may be told from other regional species of the genus by the leg pattern, the yellowish ground color of the wings, and by the elongate antennæ and halteres.

LIMNOPHILA (PRIONOLABIS) CARBONIS sp. nov. Plate 1, fig. 13; Plate 2, fig. 34.

General coloration polished black; halteres yellow; legs obscure yellow, femoral tips broadly, tibial apices more narrowly, darker; wings grayish subhyaline, patterned with brown; cell M_1 lacking; m-cu oblique, at near one-third length of cell 1st M_2; male hypopygium with tergite deeply emarginate; both dististyles simple.

Male.—Length, about 6.5 millimeters; wing, 7.8.

Rostrum and palpi black. Antennæ 16-segmented brownish black; flagellar segments oval; verticils subequal in length to the segments. Head black.

Thorax uniformly black. Halteres relatively long, pale yellow throughout. Legs with coxæ and trochanters black; femora obscure yellow, tips broadly darker, the amount subequal on

all legs; tibiæ and basitarsi pale, tips narrowly darkened; remaining tarsi dark brown. Wings (Plate 1, fig. 13) grayish subhyaline, patterned with brown, including cell C, intermediate portion of cell Sc, a broad seam along vein Cu, seams along cord and outer end of cell 1st M_2, a spot at origin of Rs, and stigma; broad, vaguer seams along veins beyond cord; prearcular field more yellow; veins pale brown, a trifle darker in clouded areas; veins of prearcular field and vein M light yellow. Venation: Sc_1 ending nearly opposite fork of R_{2+3+4}, Sc_2 near its tip, about opposite fork of Rs; R_{2+3+4} short, less than R_2; cell M_1 lacking; m-cu oblique, at near one-third length of cell 1st M_2.

Abdomen, including hypopygium, black. Male hypopygium (Plate 2, fig. 34) with caudal margin of tergite, *9t*, deeply and narrowly emarginate, lobes slender, densely setuliferous. Outer dististyle, *od*, with a large subglobular fleshy lobe at base, sclerotized portion simple, narrowed to a gently curved apex, surface with coarse setæ. Inner dististyle, *id*, simple. Gonapophyses, *g*, appearing as slender pale blades, tips curved, apices obtusely rounded.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, summit, altitude 11,000 feet, June 9, 1937 (*Tsen*).

Limnophila (*Prionolabis*) *carbonis* is quite distinct from the other regional species of the subgenus that have the body coloration polished black and cell M_1 lacking. The heavily patterned wings and structure of the male hypopygium provide excellent specific characters.

ELEPHANTOMYIA (ELEPHANTOMYIA) CARBO sp. nov. Plate 1, fig. 14; Plate 2, fig. 35.

General coloration black, including thorax and abdomen; head dark gray; halteres pale yellow; legs black, femoral bases broadly yellow, tarsi paling to yellow; wings yellow, heavily patterned with brown, including a broad seam at cord.

Male.—Length, excluding rostrum, 6.5 to 8 millimeters; wing, 8 to 9.5; rostrum, 5 to 6.2.

Rostrum only a little shorter than remainder of body, black throughout, including palpi. Antennæ black, scape slightly pruinose, pedicel reddish brown; basal two flagellar segments fused, there being twelve subcylindrical segments beyond fusion segment; outer flagellar segments with long conspicuous verticils. Head dark gray; anterior vertex relatively narrow, about as wide as diameter of scape.

Thorax uniformly black, surface subnitidous. Halteres uniformly pale yellow. Legs with coxæ black; trochanters obscure yellow; femora black, bases conspicuously yellow, narrowest (about proximal sixth) on forelegs, broadest on posterior legs (about proximal fourth); tibiæ black; proximal portion of basitarsi brownish black, remainder of tarsi paling to obscure yellow. Wings (Plate 1, fig. 14) with ground color yellow, prearcular cells brighter yellow; a rather heavy brown pattern, including cell C; stigma; broad seams along cord and outer end of cell 1st M_2; a broad seam along vein Cu, on proximal portion involving cell Cu, on distal two-thirds involving cell M; posterior wing margin, from tip back to axilla darkened; cells beyond cord somewhat darker than those in basal portion of wing, especially in paratype; veins brown, M chiefly yellow; prearcular veins bright yellow. Venation: Sc_1 ending shortly beyond fork of Rs, Sc_2 at its tip; branches of Rs generally parallel throughout their length, cell R_2 thus wider than R_3; upper branch of sector more or less sinuous, especially in paratype; cell 1st M_2 large, rectangular, m-cu at near one-third to one-fourth the length.

Abdomen, including hypopygium, black. Male hypopygium (Plate 2, fig. 35) with mesal face of basistyle with abundant setæ. Outer dististyle slender, sinuous, at apex with two unequal teeth, the larger tooth strongly decurved. Penefilum, *pf*, conspicuous.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, White Cloud Temple, altitude 9,000 feet, June 12, 1937 (*Tsen*). Paratopotype, male.

Elephantomyia (*Elephantomyia*) *carbo* is entirely different from the other described Asiatic species of the genus. The intense black color of the thorax and abdomen, in conjunction with the heavily patterned wings, readily distinguishes the species.

ERIOPTERINI

CRYPTERIA LUTEIPENNIS sp. nov. Plate 1, fig. 15; Plate 3, fig. 36.

General coloration clear gray; fusion segment of flagellum elongate, about equal in length to the succeeding five segments taken together and evidently formed by fusion of five segments; halteres yellow; legs light brown to brownish yellow, outer tarsal segments brownish black to black; wings narrow, tinged with pale yellow; cell 1st M_2 narrow, its greatest width about one-half the length; m-cu close to or before fork of M; vein 2d

A relatively short, ending some distance before level of m-cu; male hypopygium with inner dististyle much compressed, flattened.

Male.—Length, 5 to 5.5 millimeters; wing, 5.5 to 6.

Female.—Length, 6 to 6.5 millimeters; wing, 6 to 6.5.

Rostrum and palpi black. Antennæ black throughout; nine flagellar segments beyond elongate fusion segment which thus evidently comprises five segments and is about equal in length to the succeeding five segments combined; verticils subequal in length to segments, verticils of fusion segment sparse. Head light gray; eyes small; vertex broad.

Thorax clear light gray, without evident stripes or other markings. Halteres yellow. Legs with coxæ gray; trochanters light brown; remainder of legs light brown to brownish yellow, tibiæ and tarsi brownish black to black. Wings (Plate 1, fig. 15) narrow, with a uniform pale-yellow tinge, costal region more saturated; veins yellow. Venation: Vein R_{2+3} running close to R_1, narrowing distal third of cell R_1; vein R_2 lacking; cell 1st M_2 narrow, its greatest width about one-half its length; petiole of cell M_1 variable, from one and one-half to two times m; m-cu close to or a short distance before fork of M; vein 2d A relatively short, ending some distance before level of m-cu, cell narrow.

Abdominal tergites brownish black, sternites brown, their caudal margins darker; hypopygium black. Male hypopygium (Plate 3, fig. 36) with basistyle, *b*, elongate; mesal face on basal half slightly expanded, provided with a slender hair pencil. Outer dististyle, *od*, slender, simple, apex acute; before apex on distal fourth with a series of microscopic appressed teeth. Inner dististyle, *id*, broadly compressed, extensive. Gonapophyses, *g*, appearing as slightly curved blackened spines. Ovipositor with cerci elongate, horn-yellow.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, White Cloud Temple, altitude 9,000 feet, June 12, 1937 (*Tsen*). Allotopotype, female. Paratopotypes, several of both sexes.

Crypteria luteipennis is closest to *C. claripennis* (Brunetti), of the eastern Himalayas.[4] The type of *claripennis* was examined by Edwards who describes it as being very close to, if not identical with, the genotype of *Crypteria limnophiloides* Bergroth,

[4] Rec. Indian Mus. 8 (1913) 153, 154; 15 (1918) 324, fig. *d* (venation); 26 (1924) 302.

of northern Europe. Compared with the present fly, this latter species has the hypopygium quite different, and further has the fusion segment of the antennal flagellum much shorter, a little longer than the succeeding three flagellar segments combined.

GONOMYIA (LIPOPHLEPS) PARVISPINOSA sp. nov. Plate 1, fig. 16; Plate 3, fig. 37.

General coloration brownish gray, variegated with yellow, including a well-defined pleural stripe; legs black; wings pale brown, variegated with yellow; Sc_1 ending some distance before origin of Rs; abdominal segments dark brown, caudal borders conspicuously yellow; male hypopygium with outer dististyle a gently curved black rod, outer margin with microscopic appressed teeth, at base of style with a small black spine directed distad.

Male.—Length, about 3 millimeters; wing, 3.5.

Rostrum yellow; palpi black. Antennæ with scape and unusually large pedicel yellow above, darker beneath; flagellum black; verticils of basal flagellar segments unusually long. Head large, yellow, with a grayish trilobed area in center of vertex; occiput darkened.

Pronotum and broad lateral pretergites light sulphur yellow. Mesonotal præscutum, scutum, and base of scutellum dark brownish gray, posterior border of scutellum obscure yellow; mediotergite dark, with a transverse V-shaped yellow marking at near midlength. Pleura dark brownish gray, with a conspicuous pale yellow longitudinal stripe extending from and including fore coxæ, passing beneath root of halteres to abdomen; dorsopleural membrane more or less yellow. Halteres yellow, base of knob a trifle obscured. Legs with coxæ pale, fore coxæ light yellow, as described; trochanters testaceous; remainder of legs black, femoral bases restrictedly paler. Wings (Plate 1, fig. 16) variegated pale brown and pale yellow, the latter including cells C and Sc, together with areas before and beyond brown stigma; subhyaline areas in cells before and beyond cord; veins brown, brightened in yellow areas. Venation: Sc short, Sc_1 ending some distance before origin of Rs, Sc_2 close to its tip; m-cu shortly before fork of M.

Abdominal segments bicolored, dark brown, caudal borders conspicuously yellow, more obscure on sternites. Male hypopygium (Plate 3, fig. 37) with outer dististyle, *od,* a gently curved black rod, outer margin with microscopic appressed teeth; at base a small, gently curved black spine, directed outward or distad. Inner dististyle, *id,* with spine relatively long and slend-

er, exceeding height of style itself. Phallosome not evident in the only available hypopygium.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, Flying Bridges Temple, altitude 2,800 feet, June 11, 1937 (*Tsen*). Paratopotype, 1 broken male.

In the general structure of the male hypopygium the present fly is closest to *Gonomyia* (*Lipophleps*) *luteimarginata* Alexander and *G.* (*L.*) *flavocostalis* Alexander. In the former species the basal spine of the outer dististyle is not directed outwardly but is recurved basad, while the structure of the inner style is quite distinct; in *flavocostalis* the details of structure of both dististyles are entirely distinct, while the legs are not uniformly darkened, the femora being narrowly ringed with brown before apex.

GONOMYIA (GONOMYIA) PRINCIPALIS sp. nov. Plate 1, fig. 17; Plate 3, fig. 38.

Large (wing, male, over 6 millimeters); general coloration yellow and black; rostrum orange; antennæ black throughout; scutellum yellow; dorsal pleura with an incomplete dark stripe on propleura and anepisternum; halteres pale yellow; wings strongly tinged with brownish yellow; Sc long, m-cu a short distance beyond fork of M; male hypopygium with both dististyles bifid; phallosome complex, with two blackened apophyses.

Male.—Length, about 5.5 millimeters; wing, 6.5 to 6.8.

Female.—Length, about 6.5 millimeters; wing, 7.

Rostrum orange; palpi black. Antennæ black, relatively long, if bent backward extending to wing root or shortly beyond; flagellar segments elongate. Front orange; posterior portion of head dark gray.

Pronotum and lateral pretergites light sulphur yellow. Mesonotal præscutum with disc dull blackish gray, humeral region yellow, the broad lateral margins more obscure yellow; scutal lobes blackish gray, median area restrictedly obscure yellow; scutellum chiefly yellow, parascutella dark; mediotergite dark, sparsely pruinose, cephalic-lateral portions light yellow. Pleura yellow, with a narrow, abbreviated, dark-brown, longitudinal stripe extending from cervical region across ventral propleura and anepisternum; pteropleurite and pleurotergite yellow; ventral sternopleurite and meron more reddish brown. Halteres pale yellow. Legs with coxæ and trochanters yellow; remainder of legs brown, terminal tarsal segments darker. Wings (Plate 1, fig. 17) with a strong brownish yellow tinge, prearcular field and costal border clear light yellow; less distinct yellow borders

to veins, broadest and most conspicuous along veins Cu and 2d A; stigma scarcely differentiated against ground; veins light brown, yellow in luteous areas. Venation: Sc relatively long, Sc_1 ending opposite one-third to nearly midlength of Rs, Sc_2 near tip; basal section of R_5 short to obliterated, longer in female; veins R_3 and R_4 strongly divergent, cell R_3 at margin thus very wide; m-cu a short distance beyond fork of M.

Abdominal tergites dark brown, lateral borders broadly yellow, caudal margins very narrowly and inconspicuously so; sternites reddish yellow, caudal margins yellow; hypopygium yellow. Male hypopygium (Plate 3, fig. 38) with apical lobe of basistyle, *b*, relatively stout, about one-half as long as style. Outer dististyle, *od*, conspicuously bifid, the longer outer arm with numerous setæ; inner arm dilated into a dark blade. Inner dististyle, *id*, bearing a long basal arm that is nearly as long as outer style; at near midlength split into two long, acute, appressed spines. Phallosome, *p*, complex, as shown by figure, with two blackened apophyses, one strongly sinuous; apex of ædeagus a long straight spine.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, White Cloud Temple, altitude 9,000 feet, June 5, 1937 (*Tsen*). Allotopotype, female, June 12, 1937. Paratopotypes, 2 males, Chu Lao Tong Temple, altitude 6,500 feet, June 6, 1937 (*Tsen*).

Gonomyia (*Gonomyia*) *principalis* is readily told from all other regional species by the large size and by the structure of the male hypopygium.

GONOMYIA (IDIOCERA) INSIDIOSA sp. nov. Plate 1, fig. 18; Plate 3, fig. 39.

General coloration gray, præscutum with two intermediate brown stripes; pseudosutural foveæ black; antennæ black, pedicel yellow; pleura with a pale-yellow longitudinal stripe; halteres infuscated; legs brown; wings pale yellow, restrictedly patterned with brown; stigma dark brown; Sc_1 ending about opposite one-third length of Rs, Sc_2 before origin of Rs; veins R_{1+2} and R_3 close together at margin; m-cu about one and one-half times its length before fork of M; male hypopygium with three dististyles, intermediate one bifid, the two arms very unequal; inner dististyle simple; ædeagus a slender rod with slightly decurved apex.

Male.—Length, about 4.5 millimeters; wing, 5.

Rostrum and palpi black. Antennæ with scape dusky above, yellow beneath; pedicel yellow; flagellum uniformly black; flagellum 13-segmented, basal segment short-oval, outer seg-

ments more elongate. Head light gray, paler in front; anterior vertex with a dusky central spot.

Pronotum darkened medially, pale yellow on sides. Mesonotal præscutum gray, with two intermediate brown stripes, poorly indicated in front, more divergent and well-defined behind; pseudosutural foveæ black, conspicuous; scutum gray, centers of lobes darker; scutellum dull orange, restrictedly darker at base; postnotum gray. Pleura dark gray with a pale-yellow longitudinal stripe, extending from behind fore coxæ, widened behind. Halteres infuscated, base of stem restrictedly yellow. Legs with fore coxæ blackened, remaining coxæ paler, more or less variegated with yellow; trochanters yellow, fore pair darker; remaining legs brown, outer segments darker. Wings (Plate 1, fig. 18) with a pale-yellow tinge, costal border a little more saturated; stigma short-oval, dark brown, conspicuous; cord and m-cu narrowly dark brown, produced by a darkening of the veins only; veins chiefly pale, outer medial branches a little darker. Venation: Sc relatively short, Sc_1 ending about opposite one-third length of Rs, Sc_2 far from its tip, a short distance before origin of Rs; R_3 nearly erect, close to R_{1+2} at margin; vein R_4 long, gently curved; cell 2d M_2 longer than its petiole; m-cu about one and one-half times its length before fork of M.

Abdominal tergites dark brown, extreme caudal margins of individual segments yellow; basal sternites a little paler in central portions; hypopygium brown. Male hypopygium (Plate 3, fig. 39) with ventral lobe of basistyle, *b*, moderately produced, obtuse at apex. Three dististyles, the intermediate, *md*, bifid; outer style, *od*, broad at base, gradually narrowed to an acute black spinous apex, immediately before tip with three or four long setæ; intermediate style, *md*, with outer arm about four times as long as spurlike inner arm; inner style, *id*, a small simple rod, with three or four setæ along length, with other smaller setæ at apex. Ædeagus, *a*, a slender straight rod, extreme tip decurved.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, Flying Bridges Temple, altitude about 2,800 feet, June 11, 1937 (*Tsen*).

Gonomyia (*Idiocera*) *insidiosa* is very different from all described species, the relatively simple structure of the dististyles being diagnostic. In this regard, it comes closest to the otherwise entirely different *G.* (*I.*) *reticulata* Alexander.

GONOMYIA (IDIOCERA) OCTAVIA sp. nov. Plate 1, fig. 19; Plate 3, fig. 40.

General coloration light gray; antennæ with scape and pedicel white, flagellum black; halteres infuscated; legs pale brownish yellow; wings yellowish subhyaline, restrictedly patterned with dark brown, including small stigma and dark seams at origin of Rs and along cord; Sc short, Sc_1 ending a little beyond origin of Rs, Sc_2 far from its tip; R_3 nearly perpendicular, R_4 strongly arcuated; m-cu about its own length before fork of M; male hypopygium with four dististyles on either side, three slender and simple, the fourth widely expanded into a flattened scoop; ædeagus with extreme tip decurved.

Male.—Length, about 4.5 millimeters; wing, 5.2.

Rostrum brownish black, palpi black. Antennæ with scape and pedicel white, flagellum black; flagellar segments oval, verticils exceeding segments in length. Head gray, front yellow.

Pronotum and lateral pretergites yellow. Mesonotum light gray, præscutum with four very scarcely darker, poorly indicated brown stripes, laterals even less distinct; pseudosutural foveæ pale; humeral and lateral portions of præscutum obscure yellow; posterior margin of scutellum and extreme lateral margins of mediotergite obscure yellow. Pleura chiefly obscure yellow, dorsopleural region darker. Halteres infuscated. Legs with coxæ and trochanters pale; remainder of legs pale brownish yellow, terminal tarsal segments darker. Wings (Plate 1, fig. 19) yellowish subhyaline, restrictedly patterned with dark brown, including the small, short-oval stigma and narrow seams at origin of Rs, along cord and on m-cu, the latter best shown by the darkened veins; remaining veins chiefly yellow. Venation: Sc short, Sc_1 ending just beyond origin of Rs, Sc_2 far from its tip; Rs long, arcuated; vein R_3 nearly perpendicular, without trichia; distance on costa between tips of veins R_{1+2} and R_3 about one-half length of latter; vein R_4 strongly arcuated, with trichia throughout its length; cell 2d M_2 subequal to its petiole; m-cu about its own length before fork of M.

Abdominal tergites dark brown, sternites and hypopygium paler. Male hypopygium (Plate 3, fig. 40) with four dististyles or primary branches thereof; longest style, *md*, appearing as a flattened scooplike blade that is extended into a long straight spinous point, on inner margin of blade with a blackened fingerlike lobe; other dististyles all subequal in length, slender and simple, the outermost, *od*, glabrous, curved at apex into an acute

blackened point; intermediate style glabrous, most slender; innermost style simple, with scattered setæ, the tip an acute spine. Ædeagus, *a*, weakly constricted at near midlength, extreme tip decurved.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, Flying Bridges Temple, altitude about 2,800 feet, June 11, 1937 (*Tsen*).

The nearest ally is *Gonomyia* (*Idiocera*) *shantungensis* Alexander, which differs very conspicuously in the structure of the male hypopygium and in the details of wing pattern and venation.

CRYPTOLABIS (BÆOURA) PERDUCTILIS sp. nov. Plate 1, fig. 20; Plate 3, fig. 41.

General coloration of thorax dark brown; wings light gray, costal border and prearcular region conspicuously whitened; male hypopygium with dististyle exceedingly long and slender, before basal third bearing a flattened, paddlelike, lateral blade; ædeagus long and setoid in appearance.

Male.—Length, about 4 millimeters; wing, 4.3 to 4.4.

Rostrum brown; palpi brownish black. Antennæ brownish black. Head dark brown.

Thoracic dorsum almost uniformly dark brown, præscutum unstriped; scutellum not or scarcely brightened. Pleura dark. Halteres dusky, stem a little paler. Legs with coxæ and trochanters yellow; remainder of legs chiefly pale brown, inconspicuously hairy. Wings (Plate 1, fig. 20) light gray, costal border and prearcular region conspicuously whitened; a more or less distinct darker area crossing wing at cord; veins pale brown, light yellow in the white areas. Venation: R_{2+3+4} a trifle longer than R_{2+3} or R_2; m-cu before midlength of M_{3+4}; vein 2d A sinuous on distal third.

Abdomen brown, hypopygium more yellowish. Male hypopygium (Plate 3, fig. 41) with dististyle, *d*, exceedingly long and slender, sinuous, gradually narrowed to a needlelike point, just before basal third bearing a flattened, paddlelike, lateral blade. Arms of tergite, *9t*, appearing as glabrous flattened blades. Ædeagus, *a*, with basal portion slightly dilated, apical portion long-produced, unusually slender.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, Flying Bridges Temple, altitude about 2,800 feet, June 4, 1937 (*Tsen*). Paratopotype, male, June 11, 1937.

Cryptolabis (*Bæoura*) *perductilis* is entirely different from all species hitherto made known. In the produced dististyle and ædeagus it is closest to *C.* (*B.*) *dicladura* Alexander, of Hainan, yet quite distinct.

ORMOSIA BEATIFICA sp. nov. Plate 1, fig. 21.

General coloration dark brown; antennal flagellum black; halteres and legs uniformly light yellow; wings light yellow, heavily and handsomely patterned with brown, including seams along cord, M_3, and Cu; outer radial field faintly infumed.

Female.—Length, about 5.5 millimeters; wing, 6.

Rostrum brown; palpi brownish black. Antennæ with scape and pedicel dark brown; flagellum black; flagellar segments long-oval, verticils of basal segments elongate. Head brown.

Thorax almost uniformly dark brown, with conspicuous yellow vestiture. Halteres uniformly pale yellow. Legs with coxæ brown; trochanters obscure yellow; remainder of legs uniformly light yellow. Wings (Plate 1, fig. 21) light yellow, heavily and very handsomely patterned with brown; prearcular and costal fields more saturated yellow; stigma large, dark brown; smaller brown spots at origin of Rs, Sc_2, and tips of all longitudinal veins; broad paler brown washes along cord and as seams the entire length of veins M_3 and Cu, and on distal half of vein 2d A; entire outer radial field weakly infumed; veins yellow, darker in clouded areas. Macrotrichia of cells abundant (represented in figure by stippling). Venation: Vein R_3 rather strongly upcurved at tip; vein 2d A moderately sinuous.

Abdomen dark brown, caudal borders of sternites narrowly and inconspicuously paler.

Habitat.—China (Szechwan).

Holotype, female, Mount Omei, Chu Lao Tong Temple, altitude 6,500 feet, June 5, 1937 (*Tsen*).

Ormosia beatifica is readily told from all regional species in the uniformly light-yellow legs and conspicuously patterned wings. It apparently belongs to the *similis* group, but this cannot be affirmed in the absence of the male sex.

ORMOSIA DEFESSA sp. nov. Plate 1, fig. 22; Plate 3, fig. 42.

Belongs to the *similis* group; general coloration gray; antennæ (male) relatively long, if bent backward extending about to middistance between roots of wings and halteres; halteres yellow; legs dark, tibiæ with yellow vestiture; wings brownish yellow, restrictedly patterned with darker; R_2 at or shortly beyond

fork of R_{2+3+4}; male hypopygium with outer gonapophysis sinucus, outer margin with several teeth, surface with coarse scattered setæ; inner apophyses appearing as flattened plates, outer mesal angle produced into a spinous point.

Male.—Length, 4 to 4.3 millimeters; wing, 4.6 to 5.

Rostrum black; palpi brownish black. Antennæ black throughout, relatively long, if bent backward extending about to middistance between roots of wings and halteres; flagellar segments long-oval, with a dense white pubescence; more basal segments with unusually long verticils, at midlength of flagellum becoming much shorter, on outer segments much shorter than segments alone. Head dark gray, vestiture yellow.

Thorax gray, præscutum without clearly delimited stripes, vestiture yellow. Halteres short, pale yellow, stem short, knob large. Legs with coxæ dark; trochanters obscure yellow; femora dark brown; tibiæ brighter, color produced by yellow pubescence; tarsi dark brown. Wings (Plate 1, fig. 22) tinged with brownish yellow, restrictedly patterned with darker, including stigma, a seam along cord and a darkened area at fork of M_{1+2}; veins yellow, darker in clouded areas; macrotrichia of cells (indicated in figure by stippling) chiefly yellow, darker in clouded areas. Venation: R_2 at or shortly beyond fork of R_{2+3+4}, in latter case R_{2+3} thus very short; outer radial branches only slightly upcurved at tips; m-cu at fork of M.

Abdomen, including hypopygium, dark brown. Male hypopygium (Plate 3, fig. 42) with outer dististyle, *od,* flattened, squamulose, as in the group. Gonapophyses heavily blackened, outer pair, *og,* slender, sinuous, outer margin with a series of more than a dozen small teeth, with a few more obtuse teeth on inner margin near apex; surface of apophysis with abundant long setæ; inner apophyses, *ig,* shorter, appearing as flattened plates, narrowest at base, a little expanded outwardly, outer mesal angle produced into a spinous point.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, Chu Lao Tong Temple, altitude 6,500 feet, June 6, 1937 (*Tsen*). Paratopotype, male.

Ormosia defessa is apparently closest to *O. tenuispinosa* Alexander, likewise from western China, differing especially in the shorter antennæ of the male and in the structure of the male hypopygium, notably of the gonapophyses.

ERIOPTERA (ERIOPTERA) JUVENILIS Alexander. Plate 3, fig. 43.

Erioptera (Erioptera) juvenilis ALEXANDER, Philip. Journ. Sci. 50 (1933) 157, 158.

The type, a unique female, was from the Japanese Alps, Honshiu, Japan, taken August 8, 1931, by Jiro Machida. What appears to be unquestionably the same species is from Mount Omei, western China, collected at White Cloud Temple, altitude 9,000 feet, and at the summit, altitude 11,000 feet, from June 5 to 12, 1937, by Tsen.

Male hypopygium (Plate 3, fig. 43) with outer dististyle, *od*, a simple blackened rod, gradually narrowed to acute tip. Inner dististyle, *id*, exceeding one-half length of outer, at apex with an erect or slightly recurved spine; outer margin of basal half with a low flange. Gonapophyses, *g*, appearing as smooth blackened incurved horns, on inner margin of basal half produced into an acute spine.

Allotype, male, Mount Omei, Szechwan, White Cloud Temple, altitude 9,000 feet, June 12, 1937 (*Tsen*).

ERIOPTERA (ILISIA) DICHROA sp. nov. Plate 1, fig. 23; Plate 3, fig. 44.

General coloration gray; basal segments of antennæ yellow; halteres pale yellow throughout; femora brown, tips darker brown; remainder of legs dark brown; wings bicolored, yellow, stigma, veins beyond cord, and a conspicuous seam on vein Cu brown; cell 1st M_2 closed; abdomen, including hypopygium, black; male hypopygium with both gonapophyses slender and of nearly equal diameter, outer pair appearing as slender black spines.

Male.—Length, 4.7 to 5 millimeters; wing, 5.6 to 6.

Rostrum dark gray; palpi black. Antennæ with scape dark brown; pedicel light brown; basal flagellar segments yellow, outer segments infuscated. Head gray.

Pronotum obscure yellow. Mesonotum almost uniformly clear gray; præscutal stripes not or scarcely darker; mesal edges of disc of scutal lobes a little darker; scutellum more blackened. Pleura gray. Halteres pale yellow throughout. Legs with fore coxæ dark brown, remaining coxæ paler, especially posterior pair; trochanters obscure yellow; femora brown, tips darker brown; remainder of legs dark brown. Wings (Plate 1, fig. 23) clear light yellow, including veins; stigma, a seam along vein Cu, cord, and most of veins beyond latter brown, producing

a bicolored appearance; central portions of outer radial veins, vein M_{3+4} and basal portion of vein M_4 yellow. Venation: Cell 1st M_2 larger than in *postrema*, M_4 being less than twice length of M_{3+4}.

Abdomen, including hypopygium, brownish black. Male hypopygium (Plate 3, fig. 44) with outer arm of outer dististyle, *od*, relatively short and stout, coarsely toothed; inner arm relatively stout. Outer gonapophyses, *g*, appearing as slender black spines; inner apophyses slender, their thickness subequal to diameter of base of spine of outer apophyses, yellow throughout, distal fourth with delicate setulæ.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, Chu Lao Tong Temple, altitude 6,500 feet, June 5, 1937 (*Tsen*). Paratopotype, male.

The nearest ally is *Erioptera* (*Ilisia*) *postrema* Alexander, which is readily told by the unicolorous wings and by the structure of the male hypopygium, as discussed elsewhere in this report.

ERIOPTERA (ILISIA) POSTREMA Alexander. Plate 3, fig. 45.

Erioptera (*Ilisia*) *postrema* ALEXANDER, Philip. Journ. Sci. 60 (1936) 350, 351.

The type was a unique female from Mount Omei. I now possess four further specimens, including the male sex, likewise from White Cloud Temple, Mount Omei, altitude 9,000 feet, taken June 12, 1937, by Mr. Tsen Bao-chi.

The male is quite like the female in all details of coloration. Male hypopygium (Plate 3, fig. 45) when compared with that of *dichroa* (Plate 3, fig. 44) shows the outer arm of the outer dististyle, *od*, slenderer, with very small inconspicuous teeth; inner arm unusually slender. Outer gonapophyses, *g*, appearing as very slender, almost setiform spines; inner apophyses much stouter, their diameter at least four times the thickness of the spine of the outer appendage, the surface with microscopic setulæ.

Male.—Length, 5 to 5.5 millimeters; wing, 5.5 to 6.5.

Allotype, male, White Cloud Temple, Mount Omei, altitude 9,000 feet, June 12, 1937 (*Tsen*).

MOLOPHILUS (MOLOPHILUS) FURIOSUS sp. nov. Plate 1, fig. 24; Plate 3, fig. 46.

Belongs to the *gracilis* group and subgroup; general coloration black, anterior lateral pretergites restrictedly yellow; antennæ short, black throughout; halteres infuscated, knobs slightly more yellowish; legs black, femoral bases restrictedly obscure

yellow; wings strongly tinged with blackish, prearcular region restrictedly yellow; male hypopygium with ventral lobe of basistyle unusually large and flattened, with an acute blackened spine at base; outer dististyle a simple curved rod; inner dististyle bifid at apex.

Male.—Length, 3.8 to 4 millimeters; wing, 4.5 to 5.

Female.—Length, about 5 millimeters; wing, 5.2.

Rostrum and palpi black. Antennæ short, black throughout; flagellar segments oval. Head black.

Thorax uniformly black, surface subnitidous; anterior lateral pretergites restrictedly yellow. Halteres infuscated, knobs slightly more yellow. Legs black, femoral bases narrowly obscure yellow, most conspicuous on middle and posterior legs. Wings (Plate 1, fig. 24) relatively narrow, strongly suffused with blackish; prearcular field restrictedly yellow; veins and macrotrichia brownish black. Venation: R_2 and r-m about in transverse alignment; petiole of cell M_3 about three times m-cu; vein 2d A relatively long, ending beyond m-cu.

Abdomen, including hypopygium, black. Male hypopygium (Plate 3, fig. 46) with ventral lobe of basistyle, *vb*, unusually large and flattened, at its base with an acute blackened spine, directed mesad. Outer dististyle, *od*, a simple curved rod, tip acute. Inner dististyle, *id*, a little shorter, strongly curved, beyond midlength split into two long spines, one a little longer than the other. Ædeagus long and slender.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, Chu Lao Tong Temple, altitude 6,500 feet, June 6, 1937 (*Tsen*). Allotopotype, female. Paratopotypes, 5 males, June 5 and 6, 1937 (*Tsen*).

In its black coloration and, especially, the structure of the male hypopygium, the present fly is very distinct from all regional allies.

MOLOPHILUS (MOLOPHILUS) UNICLAVATUS sp. nov. Plate 3, fig. 47.

Belongs to the *gracilis* group and subgroup; general coloration dark brown; legs brown; wings subhyaline, base restrictedly more yellow; male hypopygium with a single dististyle, appearing as a powerful black rod, gently curved, at apex abruptly narrowed into a strong spine, the latter with numerous coarse setæ surrounding its base.

Male.—Length, about 2.8 millimeters; wing, 3.7.

Female.—Length, about 3.2 millimeters; wing, 3.7.

Rostrum and palpi brown. Antennæ broken. Head dark gray.

Thorax uniformly dark brown. Halteres uniformly suffused with dusky. Legs brown, trochanters a little paler. Wings subhyaline, base restrictedly more yellow; veins yellow, trichia brown. Venation: R_2 lying some distance basad of level of r-m; petiole of cell M_3 long, about three times m-cu; vein 2d A ending just before level of proximal end of m-cu.

Abdomen, including hypopygium, dark brown. Male hypopygium (Plate 3, fig. 47) with ventral lobe of basistyle, *b*, produced into a long conical point, tip obtuse, with setæ to apex. A single dististyle, *d*, appearing as a powerful rod, gently curved, at apex abruptly narrowed into a strong spine, latter at base surrounded by numerous coarse black setæ; inner margin of style back from terminal spine with a linear series of strong tubercles, each tipped with a microscopic bristle. Ædeagus slender.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, Chu Lao Tong Temple, altitude 6,500 feet, June 5, 1937 (*Tsen*). Allotopotype, female.

Molophilus uniclavatus is readily distinguished from all known species of the genus by the structure of the male hypopygium. The only other regional species having a single dististyle is *Molophilus trifilatus* Alexander, of Japan, which is in every other respect a very different fly.

ILLUSTRATIONS

[*a*, Ædeagus; *b*, basistyle; *d*, dististyle; *g*, gonapophysis; *id*, inner dististyle; *ig*, inner gonapophysis; *md*, intermediate dististyle; *od*, outer dististyle; *og*, outer gonapophysis; *p*, phallosome; *pf*, penefilum; *t*, 9th tergite; *vb*, ventral lobe of basistyle; *vd*, ventral dististyle.]

PLATE 1

FIG. 1. *Trichocera appendiculata* sp. nov., venation.
2. *Tanyptera antica* sp. nov., venation.
3. *Dictenidia glabrata* sp. nov., venation.
4. *Limonia* (*Limonia*) *perbeata* sp. nov., venation.
5. *Limonia* (*Dicranomyia*) *tseni* sp. nov., venation.
6. *Limonia* (*Dicranomyia*) *lethe* sp. nov., venation.
7. *Antocha* (*Antocha*) *flavidibasis* sp. nov., venation.
8. *Dicranota* (*Rhaphidolabis*) *præcisa* sp. nov., venation.
9. *Dicranota* (*Amalopina*) *simplex* sp. nov., venation.
10. *Dicranota* (*Amalopina*) *hyalipennis* sp. nov., venation.
11. *Oxydiscus* (*Oxydiscus*) *reductus* sp. nov., venation.
12. *Epiphragma* (*Epiphragma*) *sultana* sp. nov., venation.
13. *Limnophila* (*Prionolabis*) *carbonis* sp. nov., venation.
14. *Elephantomyia* (*Elephantomyia*) *carbo* sp. nov., venation.
15. *Crypteria luteipennis* sp. nov., venation.
16. *Gonomyia* (*Lipophleps*) *parvispinosa* sp. nov., venation.
17. *Gonomyia* (*Gonomyia*) *principalis* sp. nov., venation.
18. *Gonomyia* (*Idiocera*) *insidiosa* sp. nov., venation.
19. *Gonomyia* (*Idiocera*) *octavia* sp. nov., venation.
20. *Cryptolabis* (*Bæoura*) *perductilis* sp. nov., venation.
21. *Ormosia beatifica* sp. nov., venation.
22. *Ormosia defessa* sp. nov., venation.
23. *Erioptera* (*Ilisia*) *dichroa* sp. nov., venation.
24. *Molophilus* (*Molophilus*) *furiosus* sp. nov., venation.

PLATE 2

FIG. 25. *Trichocera appendiculata* sp. nov., male hypopygium, styli.
26. *Limonia* (*Limonia*) *perbeata* sp. nov., male hypopygium.
27. *Limonia* (*Dicranomyia*) *tseni* sp. nov., male hypopygium.
28. *Limonia* (*Dicranomyia*) *lethe* sp. nov., male hypopygium.
29. *Antocha* (*Antocha*) *nebulipennis immaculata* subsp. nov., male hypopygium.
30. *Dicranota* (*Rhaphidolabis*) *præcisa* sp. nov., male hypopygium.
31. *Dicranota* (*Amalopina*) *simplex* sp. nov., male hypopygium.
32. *Oxydiscus* (*Oxydiscus*) *reductus* sp. nov., male hypopygium.
33. *Epiphragma* (*Epiphragma*) *sultana* sp. nov., male hypopygium.
34. *Limnophila* (*Prionolabis*) *carbonis* sp. nov., male hypopygium.
35. *Elephantomyia* (*Elephantomyia*) *carbo* sp. nov., male hypopygium.

PLATE 3

FIG. 36. *Crypteria luteipennis* sp. nov., male hypopygium.
37. *Gonomyia* (*Lipophleps*) *parvispinosa* sp. nov., male hypopygium.
38. *Gonomyia* (*Gonomyia*) *principalis* sp. nov., male hypopygium.
39. *Gonomyia* (*Idiocera*) *insidiosa* sp. nov., male hypopygium.
40. *Gonomyia* (*Idiocera*) *octavia* sp. nov., male hypopygium.
41. *Cryptolabis* (*Bæoura*) *perductilis* sp. nov., male hypopygium.
42. *Ormosia defessa* sp. nov., male hypopygium.
43. *Erioptera* (*Erioptera*) *juvenilis* Alexander, male hypopygium.
44. *Erioptera* (*Ilisia*) *dichroa* sp. nov., male hypopygium.
45. *Erioptera* (*Ilisia*) *postrema* Alexander, male hypopygium.
46. *Molophilus* (*Molophilus*) *furiosus* sp. nov., male hypopygium.
47. *Molophilus* (*Molophilus*) *uniclavatus* sp. nov., male hypopygium.

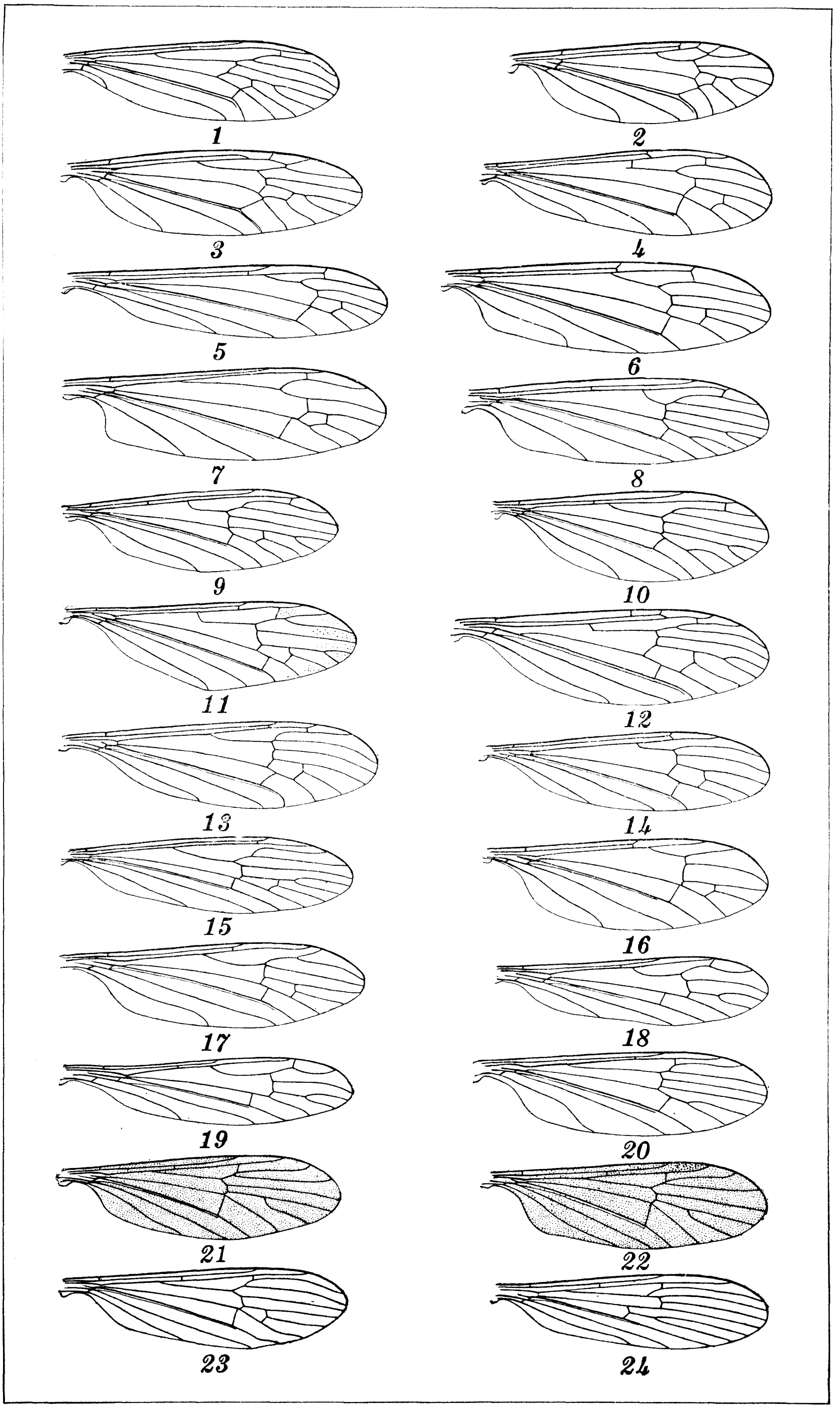

PLATE 1.

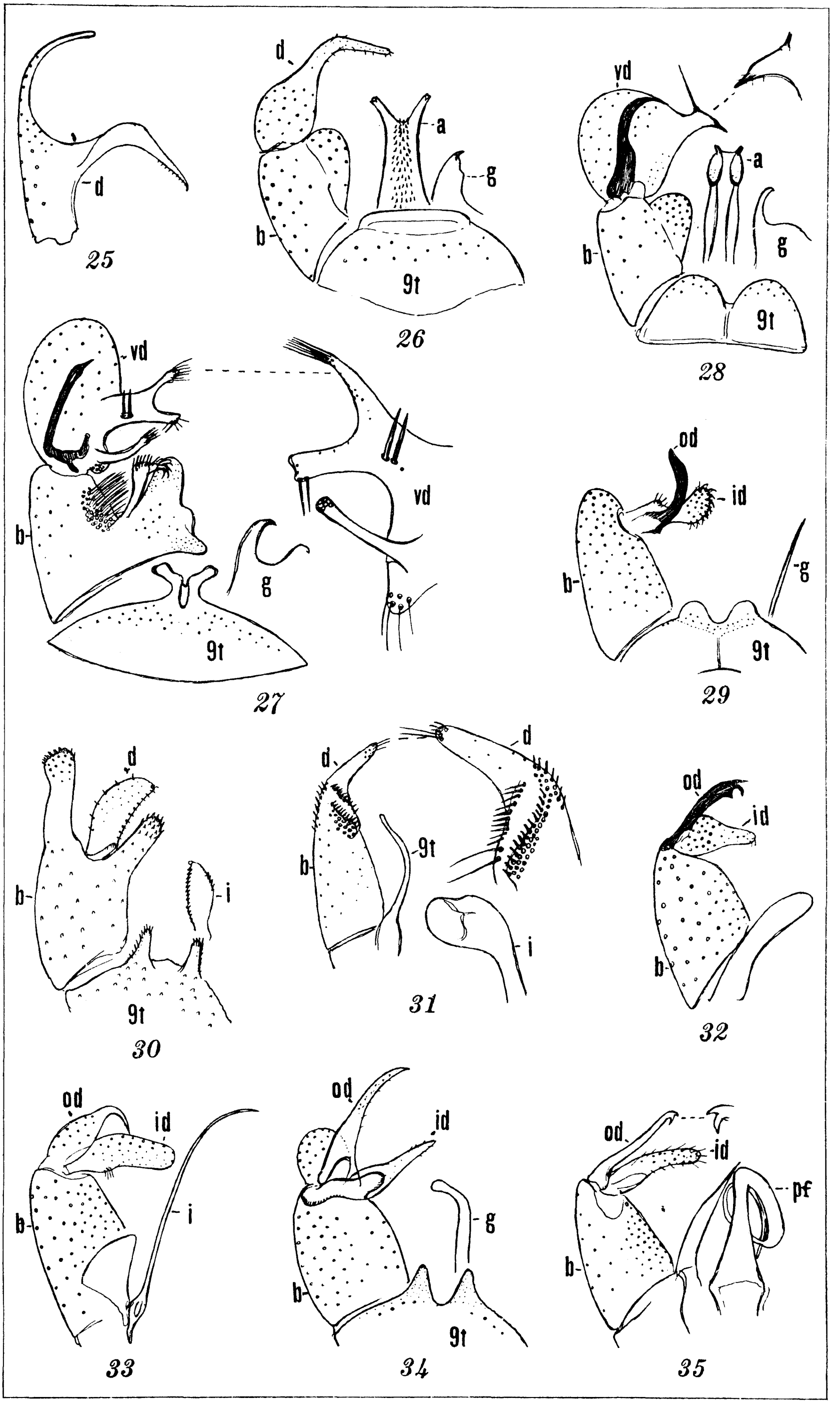
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PLATE 2.

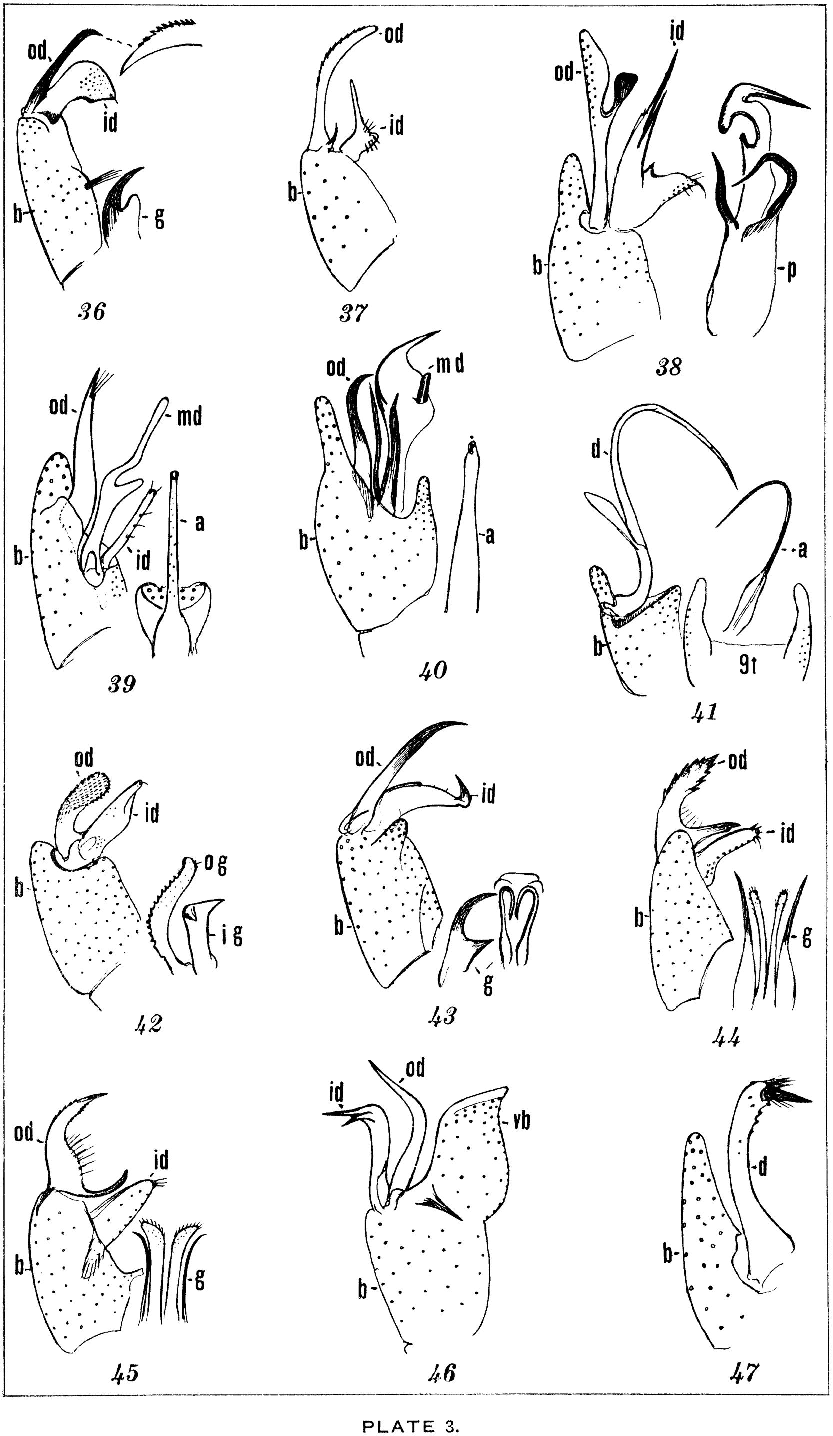
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PLATE 3.

DIATOMS FROM A MOUNTAIN BOG, KAOLINGTZE, PIN-CHIANG-SHENG PROVINCE, MANCHOUKUO

By B. W. SKVORTZOW
Of Harbin, Manchoukuo

TWO PLATES

During my last visit with Mr. P. A. Pavlov, July 15, 1926, in the mountain ranges near Kaolingtze station of the Chinese Eastern Railway, about 300 miles east from Harbin, I collected a sample of diatoms from a little mountain bog of forest mosses. In this bog the diatom flora was richly represented, quantitatively as well as qualitatively. Different *Pinnularia* species of variable size, *Eunotia* with long lunate valves, and *Gomphonema acuminatum* var. *coronata* predominated. Large numbers of cysts of different *Crysomonades* were also found in the same sample. All together 81 different diatoms were noticed. From the ecological and geographical points of view this list is of interest. Quite a large number of the forms belong to the subaërial association, others to the mountain-bog group. These two diatom associations vary in different geographical regions, and, compared with the same groups from Central Nippon, they consist ecologically of the same genera but of different species. Among the most interesting forms recorded at Kaolingtze should be mentioned two forms of *Eunotia monodon*, var. *asiatica* and var. *koreana* fo. *undulata*, reported from South Korea; *Pinnularia nodosa* var. *hankensis*, known from Lake Hanka of eastern Siberia; *Cymbella turgida* var. *muscosa* and *Caloneis sphagnicola*, recently reported from the environs of Vladivostok.

Fourteen new species, varieties, and forms, are proposed by me from this mountain bog. They are:

Eunotia parallela fo. *asiatica* fo. nov.
Achnanthes fragilis sp. nov.
Caloneis sphagnicola sp. nov.
Pinnularia molaris var. *asiatica* var. nov.
Pinnularia subcapitata fo. *constricta* fo. nov.
Pinnularia gibba fo. *constricta* fo. nov.
Pinnularia bogotensis var. *asiatica* var. nov.
Pinnularia streptoraphe var. *asiatica* var. nov.
Pinnularia distinguenda var. *asiatica* var. nov. and fo. *striolata* fo. nov.
Cymbella Pavlovi sp. nov.
Cymbella Cesati var. *asiatica* var. nov.
Nitzschia capitellata var. *montana* var. nov.
Nitzschia ignorata var. *asiatica* var. nov.

This paper includes detailed descriptions and drawings of the new forms and points out some characteristics of the known species.

MELOSIRA DISTANS (Ehr.) Kütz. var. LIRATA (Ehr.) Bethge fo. LACUSTRIS (Grun.) Bethge.

Melosira distans (Ehr.) Kütz. var. *lirata* (Ehr.) Bethge fo. *lacustris* (Grun.) Bethge, FR. HUSTEDT, Bacillar. (1930) 93, fig. 57.

Frustule with thick membrane. Valve height, 0.017 mm; breadth, 0.02. Striæ 8, puncta 6 in 0.01 mm. Infrequent. Reported from mountainous districts.

MELOSIRA ROESEANA Rabh. var. EPIDENDRON Grunow.

Melosira roeseana Rabh. var. *epidendron* Grunow, VAN HEURCK, Synopsis (1881–1885) pl. 89, figs. 17, 18.

A few specimens have been seen. Diameter of the valves 0.0187 mm. Marginal striæ 15 to 17 in 0.01 mm. Not rare.

TABELLARIA FENESTRATA (Lyngb.) Kützing.

Tabellaria fenestrata (Lyngb.) Kützing, FR. HUSTEDT, Bacillar. (1930) 122, 123, fig. 99.

Fairly common. Valve length, 0.076 mm; breadth, 0.006.

TABELLARIA FLOCCULOSA (Roth.) Kützing.

Tabellaria flocculosa (Roth.) Kützing, FR. HUSTEDT, Bacillar. (1930) 123, 124, fig. 101.

Valve length, 0.022 mm; breadth, 0.0068. Found with the preceding species.

MERIDION CIRCULARE Agardh var. CONSTRICTA (Ralfs) Van Heurck.

Meridion circulare Agardh. var. *constricta* (Ralfs) Van Heurck, FR. HUSTEDT, Bacillar. (1930) 131, fig. 119.

Several specimens have been seen. Length, 0.027 mm; breadth, 0.006.

SYNEDRA ULNA (Nitz.) Ehr.

Synedra ulna (Nitz.) Ehr., FR. HUSTEDT, Bacillar. (1930) 151, fig. 159.

Valve linear-lanceolate. Length, 0.207 mm; breadth, 0.0068. Striæ 9 in 0.01 mm. Rare.

EUNOTIA MONODON Ehr. var. KOREANA Skv. fo. UNDULATA Skvortzow. Plate 1, fig. 23.

Eunotia monodon Ehr. var. *koreana* Skv. fo. *undulata* SKVORTZOW, Neogene Diatoms from environs of Genzan, Korea (1936) pl. 1, figs. 12, 23, 24.

Valve arcuate, dorsal slightly triundulate, ventral concave. Length, 0.034 mm; breadth, 0.0068. Striæ 8 in 0.01 mm. Reported as a fossil from southern Korea.

EUNOTIA MONODON Ehr. var. ASIATICA Skvortzow.

Eunotia monodon Ehr. var. *asiatica* SKVORTZOW, Neogene diatoms from environs of Genzan, Korea (1936) pl. 1, figs. 25, 35; pl. 2, fig. 7; pl. 3, fig. 1.

Eunotia major var. *asiatica* SKVORTZOW, Alpine diatoms from South China (1929) 40, pl. 2, fig. 11.

Valve slightly curved, undulate in the middle on ventral and dorsal sides. Length, 0.085 mm; breadth, 0.008. Striæ 8 in 0.01 mm. Fairly common.

EUNOTIA PRAERUPTA Ehr. var. BIDENS Grunow.

Eunotia praerupta Ehr. var. *bidens* Grunow, FR. HUSTEDT, Bacillar. (1930) 174, fig. 213.

Common. Length, 0.066 mm; breadth, 0.012. Striæ 8 in 0.01 mm.

EUNOTIA PECTINALIS (Kütz.) Rabh. var. UNDULATA (Ralfs) Rabh.

Eunotia pectinalis (Kütz.) Rabh. var. *undulata* (Ralfs) Rabh., FR. HUSTEDT, Bacillar. (1930) 182, fig. 240.

Valve slightly arcuate with triundulate dorsal side. Ventral side only centrally undulate. Length, 0.061 mm; breadth, 0.01. Striæ 8 in 0.01 mm. A few specimens of this variety occur.

EUNOTIA ALPINA (Naeg.) Hustedt.

Eunotia alpina (Naeg.) FR. HUSTEDT, Bacillar. (1930) 185, fig. 252.

Valve narrow, filiform, curved, with broad-rounded ends. Length, 0.068 mm; breadth 0.0025. Striæ 15 in 0.01 mm. Infrequent.

EUNOTIA LUNARIS (Ehr.) Grun. var. CAPITATA Grunow.

Eunotia lunaris (Ehr.) Grun. var. *capitata* Grunow, FR. HUSTEDT, Bacillar. (1930) 185, fig. 250.

More robust than *Eunotia alpina*. Length, 0.105 mm; breadth, 0.0042. Striæ 12 to 14 in 0.01 mm. Infrequent.

EUNOTIA LUNARIS (Ehr.) Grun. var. SUBARCUATA (Naeg.) Grunow.

Eunotia lunaris (Ehr.) Grun. var. *subarcuata* (Naeg.) Grunow, FR. HUSTEDT, Bacillar. (1930) 185, fig. 251.

Smaller than the type, with slightly attenuate ends. Length, 0.027 mm; breadth, 0.004 to 0.005. Striæ 14 in 0.01 mm. Infrequent.

EUNOTIA VENERIS (Kütz.) O. Müll.

Eunotia veneris (Kütz.) O. Müll., FR. HUSTEDT, Bacillar. (1930) 182, 183, fig. 245.

Valve semielliptic, with distinct terminal nodules. Dorsal side arcuate, at ends attenuate. Length, 0.022 mm; breadth, 0.005. Striæ 13 in 0.01 mm. Not rare.

EUNOTIA TRIDENTULA Ehr. var. PERMINUTA Grunow. Plate 1, figs. 25 and 31.

Eunotia tridentula Ehr. var. *perminuta* Grunow, FR. HUSTEDT, Bacillar. (1930) 180, fig. 233; A. SCHMIDT, Atlas Diatom. (1911) pl. 273, figs. 4–6.

Valve slightly arcuate and dorsal triundulate. Terminal nodules indistinct. Length, 0.012 to 0.0136 mm; breadth, 0.0034. Striæ 15 to 18 in 0.01 mm. Infrequent.

EUNOTIA PARALLELA Ehr. fo. ASIATICA fo. nov. Plate 1, fig. 8.

Differt a typo valvis latior, striis robustris, medium dorsali constrictis. Longis valvis 0.144 mm; latis valvis 0.0125. Striis transversis 8 ad 9 in 0.01 mm. Habit. in aquis stagnalibus alpinis prope Kaolingtze, Pin-Chiang-Sheng Prov., Manchoukuo. Legit B. W. Skvortzow.

Valve arcuate, with broad-rounded ends. Dorsal side with a depression, ventral with an inflation. End nodules curved and large. Along the ventral side a distinct median line. Length, 0.144 mm; breadth, 0.0125. Striæ 8 to 9 in 0.01 mm. Differs from the type in the more robust striæ and in being slightly constricted in the middle. Common. The type is reported from moss bogs in northern Europe.

ACHNANTHES LANCEOLATA Breb.

Achnanthes lanceolata Breb., FR. HUSTEDT, Bacillar. (1930) 207, 208, fig. 306*a*.

Valve lanceolate-elliptic, with attenuate ends. Length, 0.02 mm; breadth, 0.006. Rare.

ACHNANTHES FRAGILIS sp. nov. Plate 1, fig. 26.

Valvis ellipticis cum polis rotundatis. Valva superior cum area axillaris angustata linearis, area centralis transversa dilatata. Valva inferior area centralis orbicularis. Striis delicatissimus, 40 in 0.01 mm. Habit. in aquis stagnalibus alpinis prope Kaolingtze, Pin-Chiang-Sheng Prov., Manchoukuo. Legit B. W. Skvortzow.

Valve elliptic, obtuse. Length, 0.0065 mm; breadth, 0.002. Upper valve with narrow axial and central area forming a broad rectangular fascia. Lower valve with suborbicular central area.

Striæ very fine, about 40 in 0.01 mm. A distinct minute species. Infrequent.

CALONEIS SPHAGNICOLA sp. nov. Plate 1, fig. 27.

Valvis lineari-lanceolatis ad medium modice inflatis, cum polis subcuneatis et rotundatis. Raphe directa cum poris medianis approximatis. Area axillaris anguste-linearis. Striis tenuissimis subradiantibus, 25 in 0.01 mm, medio valvae vitta transversa nuda interruptis. Longis valvis 0.039 mm; latis valvis 0.0005. Habit. in aquis stagnalibus alpinis prope Kaolingtze, Pin-Chiang-Sheng Prov., Manchoukuo. Legit B. W. Skvortzow.

Valve linear-lanceolate, with gibbous middle, and slightly attenuate ends. Median line filiform, with distinct comma-shaped terminal fissures. Axial area narrow-linear, central area a broad rectangular fascia. Striæ slightly radiate, with a distinct longitudinal band. Length, 0.039 mm; breadth, 0.005. Striæ 25 in 0.01 mm. Infrequent. A distinct species akin to *Caloneis bacillum* (Greg.) Meresch. and *Caloneis silicula* (Ehr.) Cleve. Recently found near Vladivostok in a *Sphagnum* bog.

STAURONEIS PHOENICENTERON Ehr. fo. **GRACILIS** Dippel.

Stauroneis phoenicenteron Ehr. fo. *gracilis* Dippel, FR. HUSTEDT, Bacillar. (1930).

Fairly common. Length, 0.08 mm; breadth, 0.015. Striæ 17 to 18 in 0.01 mm.

STAURONEIS ANCEPS Ehr. fo. **GRACILIS** (Ehr.) Cleve.

Stauroneis anceps Ehr. fo. *gracilis* (Ehr.) Cleve, FR. HUSTEDT, Bacillar. (1930) 256, fig. 406.

Less common than *Stauroneis phœnicenteron.* Length, 0.062 mm; breadth, 0.012. Striæ in 0.01 mm.

NAVICULA CRYPTOCEPHALA Kützing.

Navicula cryptocephala Kützing, FR. HUSTEDT, Bacillar. (1930) 295, fig. 496.

Valve lanceolate, with broad-rounded ends. Length, 0.03 mm; breadth, 0.005. Striæ 17 in 0.01 mm. Infrequent.

NAVICULA PUPULA Kütz. var. **RECTANGULARIS** (Greg.) Grunow.

Navicula pupula Kütz. var. *rectangularis* (Greg.) Grunow, FR. HUSTEDT, Bacillar. (1930) 281, fig. 467*b*.

Valve linear, with broad-rounded ends. Length, 0.02 mm; breadth, 0.0051. Not common.

NAVICULA LAGERHEIMI Cleve var. **INTERMEDIA** Hustedt. Plate 1, fig. 10.

Navicula Lagerheimii Cleve var. *intermedia* Hustedt, A. SCHMIDT, Atlas Diatom. (1930) pl. 370, fig. 22.

Valve lanceolate, with broad-rounded ends. Length, 0.03 mm; breadth, 0.0085. Striæ 18 in 0.01 mm. Reported from Harbin, Maoershan, in northern Manchoukuo, and from Shanghai and Hangchow, China. Common in the Tropics.

NAVICULA ATOMUS (Naeg.) Grunow. Plate 2, fig. 16.

Navicula atomus (Naeg.) Grunow, FR. HUSTEDT, Bacillar. (1930) 288, fig. 484.

Valve elliptic-lanceolate, with broad ends. Length, 0.0085 mm; breadth, 0.0034. Striæ 25 in 0.01 mm. Infrequent.

NAVICULA PLACENTA Ehr. Plate 2, fig. 18.

Navicula placenta Ehr., FR. HUSTEDT, Bacillar. (1930) 290, fig. 492.

Valve elliptic, with small rostrate ends. Median line filiform, with distinct central nodules. Axial area narrow-linear, central slightly enlarged. Striæ areolate, unipunctate in the system, or oblique, curved, and crossing each other. Length, 0.0408 mm; breadth, 0.0165. Striæ about 20 in 0.01 mm. New to Manchoukuo.

Genus PINNULARIA Ehrenberg

PINNULARIÆ PARALLELISTRIATÆ

PINNULARIA MOLARIS Grun. var. ASIATICA var. nov. Plate 2, fig. 24.

Differt a typo valvis robustis cum polis elongatis. Longis valvis 0.049 mm; latis valvis 0.0085. Costis 10 ad 11 in 0.01 mm. Habit. in aquis stagnalibus alpinis prope Kaolingtze, Pin-Chiang-Sheng Prov., Manchoukuo. Legit B. W. Skvortzow.

Valve linear-lanceolate, with attenuate, cuneate ends. Central area a fascia, widened outwards. Length, 0.049 mm; breadth, 0.0085. Costæ divergent in the middle and convergent at the ends, 10 to 11 in 0.01 mm. Differs from the type in its more elongate ends and more robust striæ. Infrequent.

PINNULARIÆ CAPITATÆ

PINNULARIA SUBCAPITATA Greg. Plate 2, fig. 11.

Pinnularia subcapitata Greg., FR. HUSTEDT, Bacillar. (1930) 317, fig. 571.

Valve linear, with subcapitate ends. Axial area linear, central a fascia widened outwards. Striæ divergent in the middle and convergent at the ends. Length, 0.029 mm; breadth, 0.005. Costæ 12 in 0.01 mm. Not common.

PINNULARIA SUBCAPITATA Greg. fo. CONSTRICTA fo. nov. Plate 2, fig. 9.

Differt a typo valvis modice constrictis, striis robustis. Longis valvis 0.027 ad 0.029 mm; latis valvis 0.0042 ad 0.0045. Costis

10 ad 11 in 0.01 mm. Habit. in aquis stagnalis prope Kaolingtze, Pin-Chiang-Sheng Prov., Manchoukuo. Legit B. W. Skvortzow.

Differs from the type in its slightly constricted middle part and more robust costæ. Length, 0.027 to 0.029 mm; breadth, 0.0042 to 0.0045. Costæ 10 to 11 in 0.01 mm. Not common.

PINNULARIA SUBCAPITATA Greg. var. HILSEANA (Janish) O. Müll. Plate 2, fig. 10.

Pinnularia subcapitata Greg. var. *Hilseana* (Janish) O. Müll., FR. HUSTEDT, Bacillar. (1930) 317, fig. 52.

Like the type, but with elongate and subcapitate ends. Length, 0.03 mm; breadth, 0.0042. Costæ 12 in 0.01 mm. Infrequent.

PINNULARIA MESOLEPTA (Ehr.) W. Smith. Plate 2, figs. 8 and 26.

Pinnularia mesolepta Ehr. var. *stauroneiformis* A. SCHMIDT, Atlas Diatom. (1876) pl. 45, figs. 52, 53.

Valve linear, triundulate, with capitate ends. Median line with distinct comma-shaped terminal fissures. Central area a broad transverse fascia, widened outwards. Length, 0.0408 to 0.049 mm; breadth, 0.0068. Costæ 10 to 12 in 0.01 mm. Differs from the type in its narrower valves. Not rare.

PINNULARIA MESOLEPTA (Ehr.) W. Smith fo. ANGUSTA Cleve. Plate 2, fig. 17.

Pinnularia mesolepta (Ehr.) W. Smith fo. *angusta* Cleve, FR. HUSTEDT, Bacillar. (1930) 319, fig. 575*b*.

Narrower than the type. Length, 0.04 mm; breadth, 0.0068. Costæ 10 to 11 in 0.01 mm, convergent at the ends. Rare.

PINNULARIA BRAUNII (Grun.) Cleve. Plate 2, fig. 21.

Pinnularia Braunii (Grun.) Cleve, FR. HUSTEDT, Bacillar. (1930) 319, fig. 577.

Valve elliptic-lanceolate, with produced and capitate ends. Length, 0.035 to 0.04 mm; breadth, 0.0068. Costæ 12 to 13 in 0.01 mm. Fairly common.

PINNULARIÆ DIVERGENTES

PINNULARIA MICROSTAURON (Ehr.) Cleve. Plate 2, fig. 3.

Pinnularia microstauron (Ehr.) Cleve, FR. HUSTEDT, Bacillar. (1930) 320, fig. 582.

Valve linear-lanceolate, with produced and subrostrate ends. Central area a broad fascia, widened outwards. Length, 0.046 mm; breadth, 0.0085. Costæ 11 to 12 in 0.01 mm. Infrequent.

PINNULARIÆ TABELLARIÆ

PINNULARIA GIBBA Ehr. Plate 2, figs. 14 and 25.

Pinnularia gibba Ehr., FR. HUSTEDT, Bacillar. (1930) 327, fig. 600.

Valve linear-lanceolate, with attenuate, subcapitate, cuneate ends. Axial area linear, widened towards the central area, forming a broad rectangular fascia. Terminal fissures large, comma-shaped. Costæ divergent in the middle and convergent at the ends, 8 to 9 in 0.01 mm. Length, 0.085 to 0.111 mm; breadth, 0.01 to 0.012. Common.

PINNULARIA GIBBA Ehr. var. LINEARIS Hustedt.

Pinnularia gibba Ehr. var. *linearis* Hustedt, FR. HUSTEDT, Bacillar. (1930) 327, fig. 604.

Valve linear, with obtuse-rounded ends. Length, 0.051 mm; breadth, 0.006. Costæ 10 in 0.01 mm. Less common than *Pinnularia gibba* Ehr.

PINNULARIA GIBBA Ehr. fo. SUBUNDULATA Mayer. Plate 2, fig. 4.

Pinnularia gibba Ehr. fo. *subundulata* Mayer, FR. HUSTEDT, Bacillar. (1930) 327, fig. 601.

Valve with slightly undulate margins. Length, 0.059 to 0.061 mm; breadth, 0.0072 to 0.01. Costæ 9 in 0.01 mm. Not rare.

PINNULARIA GIBBA Ehr. fo. CONSTRICTA fo. nov. Plate 2, fig. 5.

Differt a typo valvis modice constrictis. Longis valvis 0.047 mm; latis valvis 0.0068. Costis 9. Habit. in aquis stagnalibus alpinis prope Kaolingtze, Pin-Chiang-Sheng Prov., Manchoukuo. Legit B. W. Skvortzow.

Valve linear, constricted in the middle. Ends broad and rounded. Length, 0.047 mm; breadth, 0.0068. Costæ 9 in 0.01 mm. Differs from the type in its constricted valves. Infrequent.

PINNULARIA BOGOTENSIS Grun. var. ASIATICA var. nov. Plate 2, fig. 6.

Differt a typo valvis minoribus, et costis robustris. Longis valvis 0.059 mm; latis valvis 0.0085. Costis 10 ad 11 in 0.01 mm. Habit. in aquis stangalibus alpestris prope Kaolingtze, Pin-Chiang-Sheng Prov., Manchoukuo. Legit B. W. Skvortzow.

Valve linear, slightly attenuate towards the rounded and cuneate ends. Axial area somewhat dilated in the middle. Central area a broad transverse fascia. Length, 0.059 mm; breadth, 0.0085. Costæ 10 to 11 in 0.01 mm, divergent in the middle and convergent at the ends. Differs from the type [1] in its smaller size and more robust costæ. *Pinnularia bogotensis* belongs to the group of *Pinnularia gibba* and is known from New Grenada, Maine, North America, and from Korea.

[1] A. Schmidt, Atlas Diatom. (1876) pl. 44, figs. 30–32.

PINNULARIÆ DISTANTES

PINNULARIA BOREALIS Ehr.

Pinnularia borealis Ehr., FR. HUSTEDT, Bacillar. (1930) 326, fig. 597.

Valve linear, with obtuse ends. Median line robust. Costæ slightly radiate, 4 in 0.01 mm. Length, 0.039 mm; breadth, 0.01. Few specimens have been seen.

PINNULARIÆ BREVISRIATÆ

PINNULARIA BREVICOSTATA Cleve. Plate 2, fig. 13.

Pinnularia brevicostata CLEVE, Diatoms of Finland (1891) 25, pl. 1, fig. 5.

Valve linear, with obtuse-rounded ends. Median line flexuous, with large comma-shaped terminal fissures. Axial area broad-linear, central area sometimes with a rectangular fascia. Length, 0.072 mm; breadth, 0.01. Costæ 9 in 0.01 mm. Common.

PINNULARIA ACROSPHAERIA Breb.

Pinnularia acrosphaeria Breb., FR. HUSTEDT, Bacillar. (1930) 330, fig. 610.

Valve linear, with triundulate margin and capitate ends. Median line broad and punctate. Length, 0.081 mm; breadth, in the middle 0.012, at the ends 0.0156. Costæ 11 in 0.01 mm, almost parallel. Uncommon. Reported from mountainous districts.

PINNULARIA NODOSA Ehr. var. HANKENSIS Skvortzow. Plate 1, fig. 3; Plate 2, figs. 7 and 23.

Pinnularia nodosa Ehr. var. *hankensis* SKVORTZOW, Diatoms from Hanka Lake (1929) 27, pl. 5, fig. 15.

Valve linear, triundulate, with produced, subcapitate ends. Median line filiform. Axial and central areas fine-punctate. Length, 0.04 to 0.066 mm; breadth, 0.005 to 0.0068. Costæ 8 to 10 in 0.01 mm, convergent at the ends. Common. Reported from Hanka Lake, eastern Siberia.

PINNULARIÆ MAIORES

PINNULARIA MAJOR (Kütz.) Cleve var. LINEARIS Cleve fo. NEGLECTA Mayer. Plate 2, fig. 12.

Pinnularia major (Kütz.) Cleve var. *linearis* Cleve fo. *neglecta* MAYER, Die Bacillar. der Regensburger Gewässer (1912) 213, pl. 22, fig. 3.

Valve linear, with slightly attenuate-rounded ends. Median line robust, with large comma-shaped terminal fissures. Axial and central area broad-linear, more than ⅓ the breadth of valve.

Length, 0.127 mm; breadth, 0.0175. Costæ 6 in 0.01 mm, slightly divergent in the middle and convergent at the ends. Infrequent.

PINNULARIÆ COMPLEXÆ

PINNULARIA VIRIDIS (Nitz.) Ehr. var. FALLAX Cleve.

Pinnularia sp., A. SCHMIDT, Atlas Diatom. (1876) pl. 43, fig. 24.

Valve linear, with very narrow axial area. Length, 0.045 mm; breadth, 0.0085. Costæ 9 in 0.01 mm. Infrequent.

PINNULARIA VIRIDIS (Nitz.) Ehr. var. SUDETICA (Hilse) Hust.

Pinnularia viridis (Nitz.) Ehr. var. *sudetica* (Hilse) Hust., FR. HUSTEDT, Bacillar. (1930) 335, fig. 617*b*.

Valve linear-lanceolate, with slightly attenuate-rounded ends. Axial area narrow-linear, central slightly enlarged. Length, 0.078 mm; breadth, 0.012. Costæ 9 to 10 in 0.01 mm. Longitudinal band distinct. Fairly common.

PINNULARIA GENTILIS (Donk.) Cleve. Plate 2, fig. 1.

Pinnularia gentilis Donkin, A. SCHMIDT, Atlas Diatom. (1876) pl. 42, fig. 2.

Valve linear with broad-rounded ends. Median line narrow, not strongly complex. Axial area narrow, somewhat less than ¼ the breadth of valve. Costæ slightly divergent in the middle and convergent at the ends, 7 in 0.01 mm, with broad longitudinal band. Length, 0.125 mm; breadth, 0.02. Common.

PINNULARIA NOBILIS Ehr.

Pinnularia nobilis Ehr., FR. HUSTEDT, Bacillar. (1930) 337, fig. 619.

Valve linear, slightly gibbous in the middle, and broad, slightly capitate, ends. Length, 0.21 to 0.235 mm; breadth, 0.028 to 0.034. Costæ 5 to 6 in 0.01 mm. Common.

PINNULARIA STREPTORAPHE Cleve forma.

Pinnularia streptoraphe Cleve, FR. HUSTEDT, Bacillar. (1930) 337, fig. 620.

Valve linear, with parallel margins and broad-rounded ends. Length, 0.136 mm; breadth, 0.022. Axial area narrow, about ⅓ the valve breadth. Central area slightly enlarged. Median line distinct-complex. Costæ 5, slightly radiate, convergent at the ends. Smaller than the type. Longitudinal band distinct. Infrequent.

PINNULARIA STREPTORAPHE Cleve var. MINOR Cleve. Plate 1, fig. 15.

Pinnularia viridis var. *minor* CLEVE, Diatoms of Finland (1891) 22, pl. 1, fig. 2.

Valve linear, with obtuse and rounded ends. Length, 0.081 to 0.101 mm; breadth, 0.011. Costæ 8 to 9 in 0.01 mm, interrupted in the middle. Median line complex. Longitudinal band distinct. Differs from the type in its broader valve and coarser costæ. Common.

PINNULARIA STREPTORAPHE Cleve var. ASIATICA var. nov. Plate 1, fig. 16.

Minor quam forma typica, modice medium inflexis. Longis valvis 0.107 ad 0.139 mm; latis valvis 0.013 ad 0.015. Costis 6 ad 7 in 0.01 mm. Habit. in aquis stagnalibus alpinis prope Kaolingtze, Pin-Chiang-Sheng Prov., Manchoukuo. Legit B. W. Skvortzow.

Valve linear, with slightly gibbous margin and broad-rounded ends. Axial area somewhat less than $\frac{1}{4}$, the breadth of valve, linear, slightly enlarged in the middle. Median line distinct-complex. Costæ radiate in the middle, slightly convergent at the ends, 6 to 7 in 0.01 mm. Length, 0.107 to 0.139 mm; breadth, 0.013 to 0.015. Differs from the type in its smaller valves and in being slightly gibbous in the middle. Common.

PINNULARIA DISTINGUENDA Cleve. Plate 2, fig. 2.

Pinnularia viridis var. *distinguenda* CLEVE, Diatoms of Finland (1891) 22, pl. 1, fig. 1.

Valve linear, gibbous in the middle. Ends rounded. Axial area linear, somewhat less than $\frac{1}{4}$ of valve breadth. Central area slightly enlarged. Median line not strongly complex. Costæ divergent in the middle and convergent at the ends, with distinct, narrow, longitudinal band. Length, 0.153 mm; breadth, 0.02. Costæ 7 to $7\frac{1}{2}$ in 0.01 mm. Common.

PINNULARIA DISTINGUENDA Cleve var. ASIATICA var. nov. Plate 1, figs. 4 and 14.

Differt a typo valvis angustis, striis vittam longitudinalem arcuatam notatae. Longis valvis 0.083 mm; latis valvis 0.015. Costis 6 ad 7 in 0.01 mm. Habit. in aquis stagnalis alpinis prope Kaolingtze, Pin-Chiang-Sheng Prov., Manchoukuo. Legit B. W. Skvortzow.

Valve linear, with parallel margins and more or less cuneate ends. Axial area linear, central enlarged. Median line strongly complex. Costæ robust, 6 to 7 in 0.01 mm, with broad longitu-

dinal band. Length, 0.093 to 0.105 mm; breadth, 0.015 to 0.017. Differs from the type in its narrower valves and in the presence of distinct longitudinal bands. Common.

PINNULARIA DISTINGUENDA Cleve var. **ASIATICA** var. nov. fo. **STRIOLATA** fo nov. Plate 1, figs. 1 and 2.

Valvis var. asiatica consimilis. Differt striis fronte viza hyalina, pone longitudinali striolata. Longis valvis 0.09 mm; latis valvis 0.015. Costis 6 ad 7 in 0.01 mm. Habit. in aquis stagnalibus alpinis prope Kaolingtze, Pin-Chiang-Sheng Prov., Manchoukuo. Legit B. W. Skvortzow.

Valve linear, with distinct cuneate-obtuse ends. Axial area linear, central suborbicular. Median line complex. Costæ 6 to 7 in 0.01 mm, hyaline above, lineate below. Common.

PINNULARIA ISOSTAURON (Ehr.) Grunow. Plate 1, fig. 19; Plate 2, fig. 15.

Pinnularia isostauron (Ehr.) A. GRUNOW, Arctische Diatomeen (1880) 27, pl. 1, fig. 14.

Valve linear, with slightly attenuate and rounded ends. Median line indistinctly complex. Axial and central area broad-linear, in the middle with short rectangular fascia. Longitudinal bands distinct or indistinct. Length, 0.052 to 0.062 mm; breadth, 0.01. Costæ 7 to 8 in 0.01 mm, slightly radiate in the middle and convergent at the ends. Common. Broader than the type.

AMPHORA OVALIS Kütz. var. **LIBYCA** (Ehr.) Cleve.

Amphora libyca Ehr., A. SCHMIDT, Atlas Diatom. (1875) pl. 26, fig. 105.

Frustule elliptic, with truncate ends. Length, 0.03 mm; breadth, 0.008. Dorsal sides of central area a rectangular unilateral stauros. Infrequent.

CYMBELLA VENTRICOSA Kützing.

Cymbella ventricosa Kützing, FR. HUSTEDT, Bacillar. (1930) 359, fig. 661.

Common. Length, 0.02 mm; breadth, 0.005. Striæ 12 to 13 in 0.01 mm.

CYMBELLA TURGIDA (Greg.) Cleve. Plate 1, fig. 17.

Cymbella turgida (Greg.) Cleve, FR. HUSTEDT, Bacillar. (1930) 358, fig. 660.

Valve semielliptic or boat-shaped, with straight ventral and arcuate dorsal side. Length, 0.0289 mm; breadth, 0.0052. Ventral and dorsal striæ 9 in 0.01 mm. Smaller than the type.

Var. *minor* Skv., akin to this species, was described by the writer from Ikeda Lake, Nippon. Infrequent.

CYMBELLA TURGIDA (Greg.) Cleve var. **MUSCOSA** Skvortzow. Plate 1, fig. 18.

Cymbella turgida (Greg.) Cleve var. *muscosa* SKVORTZOW, Fresh-water diatoms from the environs of Vladivostok pl. 1, fig. 17.

Valve lunate, with slightly gibbous ventral and arcuate dorsal margins. Ends attenuate. Length, 0.039 mm; breadth, 0.0085. Dorsal and ventral striæ 8 in 0.01 mm. Infrequent. Reported from a moss bog from the environs of Vladivostok, eastern Siberia.

CYMBELLA GRACILIS (Rabh.) Cleve.

Cymbella gracilis (Rabh.) Cleve, FR. HUSTEDT, Bacillar. (1930) 359, fig. 663.

Valve asymmetrical, narrow, semielliptic, with long and obtuse ends. Length, 0.039 mm; breadth, 0.0068. Ventral striæ 10, dorsal 8 in 0.01 mm. Common. Reported from mountain districts.

CYMBELLA PAVLOVI sp. nov. Plate 1, fig. 28.

Valvis asymmetricis, naviculiformis, anguste-ellipticis et lanceolatis, modice arcuatis ad marginem leniter inflatis, cum polis subrostratis et subcapitatis. Raphe modice curvata. Area axilliaris linearis-angustata, centralis rodundata. Striis radiantibus ventralis 12, dorsalis 11, polis 18 in 0.01 mm. Longis valvis 0.04 mm; latis valvis 0.009. A grege *Cymbella naviculiformis* Auersv. et *Cymbella amphycephala* Naeg. et *Cymbella similis* Kraske. Habit. in aquis stagnalibus alpinis prope Kaolingtze, Pin-Chang-Sheng Prov., Manchoukuo. Legit B. W. Skvortzow.

Valve asymmetrical, naviculiform, with one side straight, the other slightly convex. Median line straight and filiform. Axial area linear, somewhat less than $\frac{1}{4}$ of the valve breadth. Central area broad, suborbicular. Striæ radiate throughout. Length, 0.04 mm; breadth, 0.009. Ventral striæ 12, dorsal 11, at the ends 18 in 0.01 mm. Infrequent.

CYMBELLA CESATI (Rabh.) Grun. var. **ASIATICA** var. nov. Plate 2, fig. 20.

Differt a typo striis robustis et area axillaris et centralis angusto lanceolatis. Longis valvis 0.051 mm; latis valvis 0.006. Striis ventralis 13, dorsalis 12 in 0.01 mm. Habit. in aquis stagnalis prope Kaolingtze, Pin-Chang-Sheng Prov., Manchoukuo, Legit B. W. Skvortzow.

Valve slightly asymmetrical, narrow-lanceolate, with long-attenuate ends. Median line with large bayonet-shaped terminal

fissures and distinct central nodules bent to one side. Axial and central areas narrow-lanceolate. Striæ radiate, slightly convergent at the ends, ventral 13, dorsal 12 in 0.01 mm. Length, 0.051 mm; breadth, 0.006. Differs from the type in its more robust striæ. Infrequent. Known from Europe in mountainous districts.

GOMPHONEMA ACUMINATUM Ehr. var. CORONATA (Ehr.) W. Smith.

Gomphonema acuminatum Ehr. var. *coronata* (Ehr.) W. Smith, FR. HUSTEDT, Bacillar. (1930) 370, fig. 680.

Length, 51 mm; breadth, 0.0085. Striæ 10 in 0.01 mm. Very common.

GOMPHONEMA ACUMINATUM Ehr. var. TURRIS (Ehr.) Cleve. Plate 1, fig. 5.

Gomphonema acuminatum Ehr. var. *turris* (Ehr.) Cleve, A. SCHMIDT, Atlas Diatom. (1902) pl. 239, fig. 36.

Valve clavate, with elongate and cuneate upper part and attenuate subacute lower part. Isolated puncta distinct. Length, 0.044 mm; breadth, 0.0068. Striæ 9 in 0.01 mm. Infrequent.

GOMPHONEMA PARVULUM (Kütz.) Grunow.

Gomphonema parvulum (Kütz.) Grunow, FR. HUSTEDT, Bacillar. (1930) 372, fig. 713*a*.

Common. Length, 0.022 mm; breadth, 0.005. Striæ 12 in 0.01 mm.

GOMPHONEMA PARVULUM (Kütz.) Grun. var. EXILISSIMA Grunow.

Gomphonema parvulum (Kütz.) Grun. var. *exilissima* Grunow, VAN HEURCK, Synopsis (1881–1885) pl. 25, fig. 12.

Length, 0.017 mm; breadth, 0.0034. Striæ 12 to 13 in 0.01 mm. Infrequent.

GOMPHONEMA ANGUSTATUM (Kütz.) Rabh. Plate 1, figs. 12 and 13.

Gomphonema angustatum (Kütz.) Rabh., A. SCHMIDT, Atlas Diatom. (1902) pl. 234, figs. 23, 24.

Valve clavate, with apex more robust than the lower part of the valve. Length, 0.018 to 0.027 mm; breadth, 0.0048 to 0.005. Striæ 15 in 0.01 mm. Not common.

GOMPHONEMA ANGUSTATUM (Kütz.) Rabh. var. SACROPHAGUS (Greg.) Crunow. Plate 2, fig. 22.

Gomphonema angustatum (Kütz.) Rabh. var. *sacrophagus* (Greg.) Grunow, A. SCHMIDT, Atlas Diatom. (1902) pl. 234, fig. 36.

Valve with parallel margins and obtuse rostrate ends. Length, 0.022 mm; breadth, 0.0051. Striæ 9 in 0.01 mm. Infrequent.

GOMPHONEMA ANGUSTATUM (Kütz.) Rabh. var. UNDULATA Grunow. Plate 1, fig. 11.

Gomphonema angustatum (Kütz.) Rabh. var. *undulata* Grunow, FR. HUSTEDT, Bacillar. (1930) 373, fig. 694.

Valve clavate-lanceolate, with slightly triundulate margins. Apex obtuse. Length, 0.032 mm; breadth, 0.005. Not common.

GOMPHONEMA INTRICATUM Kütz. var. PUMILA Grunow. Plate 1, fig. 20.

Gomphonema intricatum Kütz. var. *pumila* Grunow, A. SCHMIDT, Atlas Diatom. (1902) pl. 234, figs. 56, 57.

Valve clavate, tapering from the middle to the subacute ends. Striæ robust, 12 in 0.01 mm. Length, 0.022 mm; breadth, 0.0034. Rare.

HANTZSCHIA AMPHIOXYS (Kütz.) Grun. fo. CAPITATA O. Müll.

Hantzschia amphioxys (Kütz.) Grun. fo. *capitata* O. Müll., FR. HUSTEDT, Bacillar. (1930) 394, fig. 748.

Valve slightly arcuate, with capitate ends. Length, 0.059 mm; breadth, 0.0068. Keel puncta 7, striæ 18 to 20 in 0.01 mm. Infrequent.

HANTZSCHIA AMPHIOXYS (Kütz.) Grun. var. RUPESTRIS Grunow. Plate 1, fig. 29.

Hantzschia amphioxys (Kütz.) Grun. var. *rupestris* Grunow, A. SCHMIDT, Atlas Diatom. (1922) pl. 345, fig. 14.

Valve arcuate, with concave dorsal margin and rostrate ends. Length, 0.064 mm; breadth, 0.01. Keel puncta 5, striæ 13 in 0.01 mm. Infrequent.

HANTZSCHIA AMPHIOXYS (Ehr.) Grun. var. GRACILIS Hustedt. Plate 1, fig. 6.

Hantzschia amphioxys (Ehr.) Grun. var. *gracilis* Hustedt, A. SCHMIDT, Atlas Diatom. (1921) pl. 329, figs. 6–8.

Longer than the preceding variety. Ends attenuate and reflexed. Length, 0.17 mm; breadth, 0.012. Keel puncta 7, striæ 15 to 17 in 0.01 mm. Reported from fresh water in Europe.

NITZSCHIA PALEA (Kütz.) W. Smith. Plate 1, fig. 21.

Nitzschia palea (Kütz.) W. Smith, VAN HEURCK, Synopsis (1881–1885) pl. 99, fig. 22.

Valve linear, with parallel margins and attenuate ends. Length, 0.027 mm; breadth, 0.0034. Costæ 12 to 13 in 0.01 mm. Striæ indistinct. Common.

NITZSCHIA FRUSTULUM (Kütz.) Grun. var. PERMINUTA Grunow. Plate 1, fig. 7; Plate 2, fig. 19.

Nitzschia frustulum (Kütz.) Grun. var. *tenella* Grun., VAN HEURCK, Synopsis (1881–1885) pl. 99, fig. 30.

Valve linear, with slightly attenuate and obtuse ends. Length, 0.015 to 0.0238 mm; breadth, 0.002 to 0.0025. Keel puncta 10 to 12, striæ about 30 in 0.01 mm. Infrequent.

NITZSCHIA PARVULA Lewis. Plate 1, fig. 22.

Nitzschia parvula Lewis, A. SCHMIDT, Atlas Diatom. (1921) pl. 336, figs. 12–19.

Valve slightly sigmoid, constricted in the middle. Length, 0.035 mm; breadth, 0.005. Keel puncta 7 to 8 in 0.01 mm, striæ indistinct. Reported from fresh and brackish water.

NITZSCHIA CAPITELLATA Hust. var. MONTANA var. nov. Plate 1, fig. 24.

Valvis linearis, prae formae typica minores et latior. Longis valvis, 0.027 mm; latis valvis 0.0025. Punctis carinalibus 12, striis transversis indistinctis, delicatissimis. Habit. in aquis stagnalis prope Kaolingtze, Pin-Chang-Sheng Prov., Manchoukuo. Legit B. W. Skvortzow.

Valve linear with parallel margins and attenuate-capitate ends. Keel puncta 12 in 0.01 mm. Striæ very fine. Length, 0.027 mm; breadth, 0.0025. Differs from the type in its smaller size and broader valves. Infrequent.

NITZSCHIA IGNORATA Krasske var. ASIATICA var. nov. Plate 1, fig. 30.

Valvis sigmoidea, prae forma typica polis attenuatis et subacutis. Longis valvis 0.074 ad 0.076 mm; latis valvis 0.005 ad 0.0055. Punctis carinalibus 5 ad 7 in 0.01 mm. Striis transversalis indistinctis. Habit. in aquis stagnalibus alpinis prope Kaolingtze, Pin-Chiang-Sheng Prov., Manchoukuo. Legit B. W. Skvortzow.

Valve slightly sigmoid, elongate, with parallel margins and cuneate-obtuse ends. Length, 0.074 to 0.076 mm; breadth, 0.005 to 0.0055. Keel puncta 5 to 7 in 0.01 mm. Striæ very fine, indistinct. Differs from the type in its abruptly attenuate and subacute ends. The type is reported from fresh water in Europe.

STENOPTEROBIA INTERMEDIA (Lewis). Plate 1, fig. 9.

Stenopterobia intermedia (Lewis) FR. HUSTEDT, Bacillar. (1930) 428, 429, fig. 830.

Valve strongly sigmoid, slightly attenuate towards the ends. Length, 0.091 mm; breadth, 0.0055. Costæ 4, striæ 20 in 0.01 mm. Smaller than the type. An alpine diatom.

SURIRELLA ANGUSTATA Kützing.

Surirella angustata Kützing, FR. HUSTEDT, Bacillar. (1930) 435, figs. 844, 845.

Length, 0.034 mm; breadth, 0.0068. Costæ 5 in 0.01 mm. Common.

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ILLUSTRATIONS

PLATE 1

FIGS. 1 and 2. *Pinnularia distinguenda* Cleve var. *asiatica* fo. ***striolata*** **fo. nov.**

FIG. 3. *Pinnularia nodosa* Ehr. var. *hankensis* Skv.
4. *Pinnularia distinguenda* Cleve var. *asiatica* var. nov.
5. *Gomphonema acuminatum* Ehr. var. *turris* (Ehr.) Cleve.
6. *Hantzschia amphioxys* (Ehr.) Grun. var. *gracilis* Grun.
7. *Nitzschia frustulum* (Kütz.) Grun. var. *perminuta* Grun.
8. *Eunotia parallela* Ehr. fo. *asiatica* fo. nov.
9. *Stenopterobia intermedia* (Lewis).
10. *Navicula Lagerheimii* Cleve var. *intermedia* Hust.
11. *Gomphonema angustatum* (Kütz.) Rabh. var. *undulata* Grun.

FIGS. 12 and 13. *Gomphonema angustatum* (Kütz.) Rabh.

FIG. 14. *Pinnularia distinguenda* Cleve var. *asiatica* var. nov.
15. *Pinnularia streptoraphe* Cleve var. *minor* Cleve.
16. *Pinnularia streptoraphe* Cleve var. *asiatica* var. nov.
17. *Cymbella turgida* (Greg.) Cleve.
18. *Cymbella turgida* (Greg.) Cleve var. *muscosa* Skv.
19. *Pinnularia isostauron* (Ehr.) Grun.
20. *Gomphonema intricatum* Kütz. var. *pumila* Grun.
21. *Nitzschia palea* (Kütz.) W. Smith.
22. *Nitzschia parvula* Lewis.
23. *Eunotia monodon* Ehr. var. *koreana* Skv. fo. *undulata* Skv.
24. *Nitzschia capitellata* Hust. var. *montana* var. nov.
25. *Eunotia tridentula* Ehr. var. *perminuta* Grun.
26. *Achnanthes fragilis* sp. nov.
27. *Caloneis sphagnicala* sp. nov.
28. *Cymbella Pavlovi* sp. nov.
29. *Hantzschia amphioxys* (Kütz.) Grun. var. *rupestris* Grun.
30. *Nitzschia ignorata* Krasske var. *asiatica* var. nov.
31. *Eunotia tridentula* Ehr. var. *perminuta* Grun.

PLATE 2

FIG. 1. *Pinnularia gentilis* (Donk.) Cleve.
2. *Pinnularia distinguenda* Cleve.
3. *Pinnularia microstauron* (Ehr.) Cleve.
4. *Pinnularia gibba* Ehr. fo. *subundulata* Mayer.
5. *Pinnularia gibba* Ehr. fo. *constricta* fo. nov.
6. *Pinnularia bogotensis* Grun. var. *asiatica* var. nov.
7. *Pinnularia nodosa* Ehr. var. *hankensis* Skv.
8. *Pinnularia mesolepta* (Ehr.) W. Smith.
9. *Pinnularia subcapitata* Greg. fo. *constricta* fo. nov.
10. *Pinnularia subcapitata* Greg. var. *Hilseana* (Janish) O. Müll.

FIG. 11. *Pinnularia subcapitata* Greg.
12. *Pinnularia major* (Kütz.) Cleve var. *linearis* Cleve fo. *neglecta* Mayer.
13. *Pinnularia brevicostata* Cleve.
14. *Pinnularia gibba* Ehr.
15. *Pinnularia isostauron* (Ehr.) Grun.
16. *Navicula atomus* (Naeg.) Grun.
17. *Pinnularia mesolepta* (Ehr.) W. Smith fo. *angusta* Cleve.
18. *Navicula placenta* Ehr.
19. *Nitzschia frustulum* (Kütz.) Grun. var. *perminuta* Grun.
20. *Cymbella Cesati* (Rabh.) Grun. var. *asiatica* var. nov.
21. *Pinnularia Braunii* (Grun.) Cleve.
22. *Gomphonema angustatum* (Kütz.) Rabh. var. *sacrophagus* (Greg.) Grun.
23. *Pinnularia nodosa* Ehr. var. *hankensis* Skv.
24. *Pinnularia molaris* Grun. var. *asiatica* var. nov.
25. *Pinnularia gibba* Ehr.
26. *Pinnularia mesolepta* (Ehr.) W. Smith.

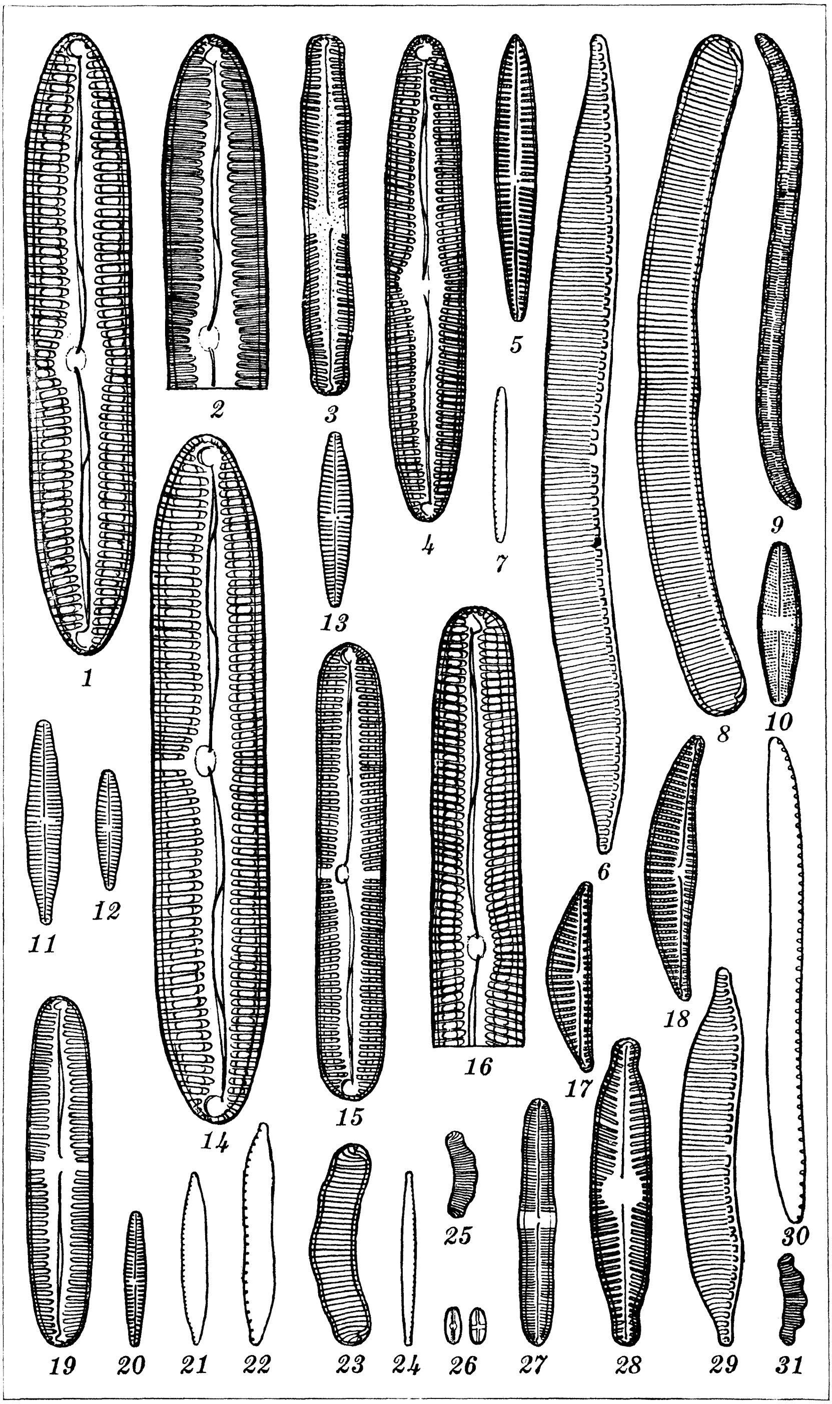
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PLATE 1.

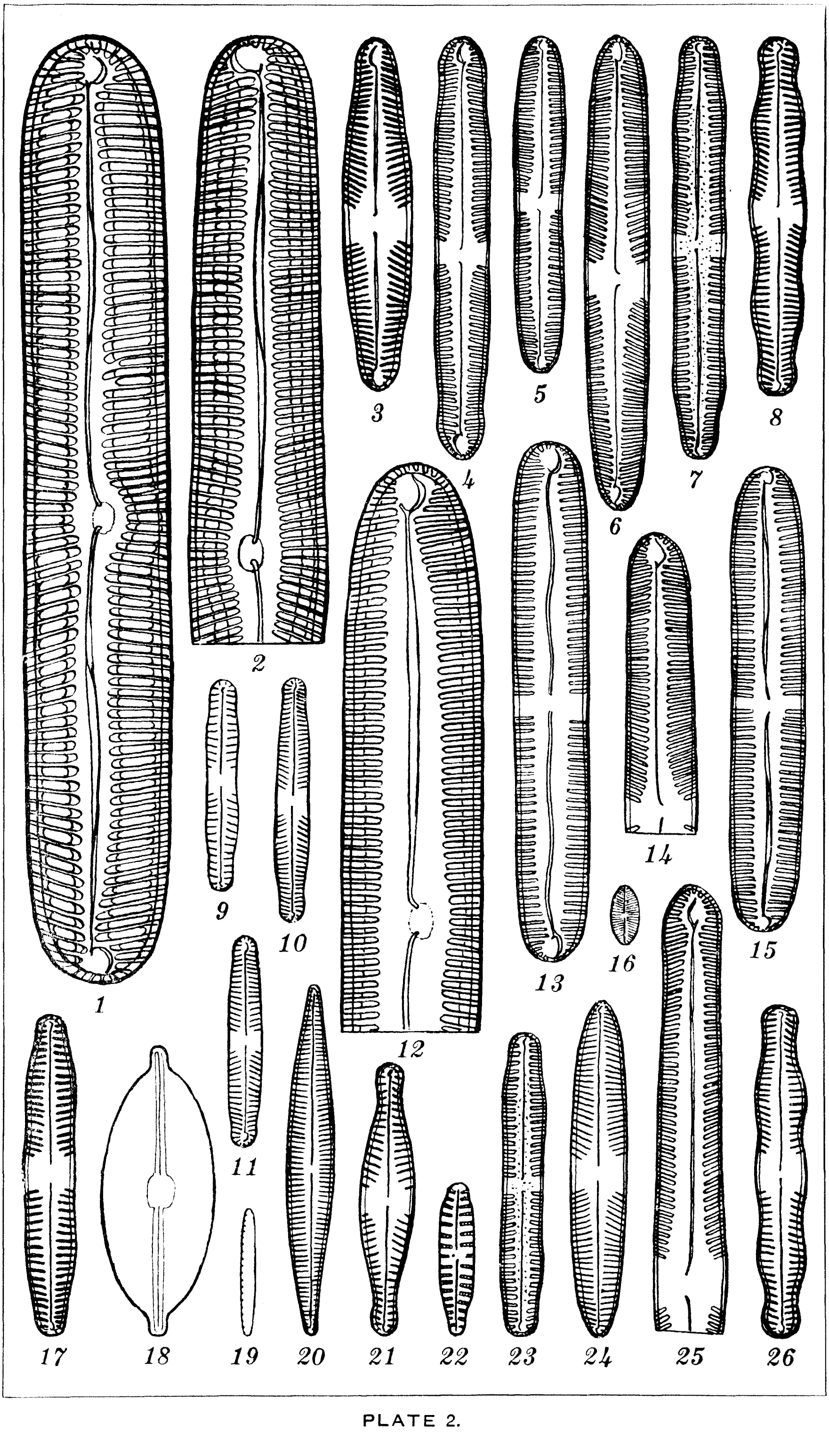

PLATE 2.

A REVISION OF PHILIPPINE LEPIOTA

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SEVEN PLATES

Revision of the genus *Lepiota* in the Philippines is necessary because of existing nomenclatural confusion. For example, what is called *L. chlorospora* in the Philippines is *L. morgani* in the United States. Besides, some species have two or more names, like *L. candida,* a species of Copeland, which is named *L. pulcherrima* by Graff who regarded it as a new species. Another interesting case is *L. americana* Peck, later described in the Philippines by Copeland as *Psalliota* (*A.*) *boltoni.*

Many of the species here described are reported for the first time from the Philippines.

Genus LEPIOTA Fries

Lepiota Fries, Syst. Myc. 1 (1836) 19; Cooke, Hdbk. Brit. Fungi (1871) 11; Sacc., Syll. Fung. 5 (1877) 27; Massee, Brit. Fungus-Flora 3 (1893) 232; Morgan, Journ. Mycol. 12 (1906) 154–156; Atkinson, Mushrooms (1911) 77; Kauffman, Agaricaceae of Mich. 1 (1918) 625; Brown, Minor Philip. Forest Products 3 (1921) 183; Rea, Brit. Basidiomycetae (1922) 64; Ramsbottom, Hdbk. Larger Brit. Fung. (1923) 28; Krieger, N. Y. Ste. Mus. Hdbk. 11 (1935) 369.

Pileus scaly from breaking up of cuticle, rarely smooth, often white, sometimes tinged yellow, red, or brown. Stem central, stuffed, easily separable from pileus, soft, fleshy, or firm. Gills white, sometimes changing color in age or when bruised or covered by green mass of spores; usually free, very rarely adnate or adnexed. Volva lacking, veil present, forming a ring on stem. Annulus persistent, easily disappearing in many species; cottony or fibrillose. Spores white except in *L. chlorospora,* where they are greenish in mass, and varying in shape, usually somewhat long, nearly spindle-shaped, elliptical, or ovate.

Taste mild. Many species are edible, a few are poisonous or mildly poisonous. The species are large or small, fleshy, firm or soft, not reviving when wet. Growing on the ground, especially manured ground, on debris, or on disintegrated wood in forests.

Key to the Philippine species of Lepiota.

a[1]. Spore print in mass greenish.. 3. *L. morgani.*
a[2]. Spore print in mass white.
b[1]. Plants caespitose .... 2. *L. cepaestipes.*
b[2]. Plants not caespitose.
c[1]. When bruised entire plant turns pinkish to reddish brown.
d[1]. Stem stout; pileus slightly umbonate..................... 4. *L. americana.*
d[2]. Stem slender, pileus strongly umbonate........ 1. *L. philippinensis.*
c[2]. When bruised entire plant turns brown to dark brown.
d[1]. Pileus floccose .... 7. *L. candida.*
d[2]. Pileus powdery .... 12. *L. gracilenta.*
d[3]. Pileus warty .... 10. *L. hispida.*
d[4]. Pileus scaly.
e[1]. Scales yellow.
f[1]. Spores elliptic .... 8. *L. denundata.*
f[2]. Spores elongate .... 9. *L. metulispora.*
e[2]. Scales reddish brown .... 5. *L. cristata.*
e[3]. Scales violet-purple .... 6. *L. lilacea.*
e[4]. Scales wood brown .... 11. *L. meleagris.*

LEPIOTA PHILIPPINENSIS Mendoza sp. nov. Plate 1, figs. 1 and 2.

Praedita est haec species: pileo primum ovato, posthac instar umbonis, campanulato, plano, quasi albi coloris, cuti operto, qui se convertit in squamas crassas atque separabiles, 5 cm ad 12 cm latas, sed ad marginem portat fibrillas; stipite farto, subfusco, squamis parvis ac quasi fusci coloris tecto, ad basem bulboso, 6 cm ad 15 cm $\times$ 9 mm ad 13 mm in diametro qui gradatim se minuit ad 4 mm ad 7 mm supra annulum; lamellis coartatis, mollibus, ventriosis, nonaffixis, a stipite segregatis collo cartilagineo; annulo crasso atque mobili; carne crassa, alba et floccosa; sporis hyalinis; ellipticis, glabris, 6.6 ad 9.6 $\mu \times$ 3 ad 5.4 μ; basidiis clavitis, 15 ad 21 $\mu \times$ 3.5 ad 4.5 μ.

Pileus 5 to 12 cm in diameter, whitish, covered with Mikado brown[1] cuticle which breaks up into thick separable scales; ovate, acorn-shaped, later campanulate and flattened, with a broad, prominent, conical umbo; margin covered with small fibrils. Stem whitish to brownish, surface layer breaking up into small brownish scales, covered with delicate, long, fine fibers, 6 to 15 cm long, 9 to 13 mm in diameter at the base, above ring 4 to 7 mm in diameter, slender, tapering upward from a bulb. Gills ventricose, crowded, soft, often becoming fuscous at edge; free, separated by a cartilaginous collar from stem. Flesh thick, white, floccose. Annulus thick, movable, white

[1] The color nomenclature is based on Ridgway's Color Standards and Color Nomenclature, Washington, D. C. (1912).

above, brownish exteriorly. Spores hyaline, smooth, elliptic, 6.6 to 9.6 μ long, 3.0 to 5.4 μ broad; average 8.4 μ long, 5.3 μ broad. Basidia clavate, 15 to 21 μ long, 3.5 to 4.5 μ broad.

On the ground and under trees; very common during wet season from June to September.

LUZON, Manila, *Philip. Nat. Herb. 1086 P. S. Gener,* May 17, 1934; *Philip. Nat. Herb. 1272 P. S. Gener,* May 21, 1934, on the ground; *Philip. Nat. Herb. 1285 P. S. Gener,* May 22, 1934, on the ground; *Philip. Nat. Herb. 1286 P. S. Gener,* May 24, 1934, on the ground; *Philip. Nat. Herb. 2068 P. S. Gener,* September 12, 1934, on the ground; *Philip. Nat. Herb. 2352 Jesus Conosa,* May 10, 1935, on the ground; *Philip. Nat. Herb. 2353 P. S. Gener,* May 9, 1935; *Philip. Nat. Herb. 2402 P. S. Gener,* May 24, 1935, on the ground; *Philip. Nat. Herb. 2416 P. S. Gener,* May 27, 1935, on horse dung; *Philip. Nat. Herb. 2490 P. S. Gener,* July 5, 1935, on the ground; *Philip. Nat. Herb. 2491 J. M. Mendoza,* July 12, 1935, on the ground; *Philip. Nat. Herb. 2543 P. S. Gener,* July 23, 1935, on the ground; *Bur. Sci. 55108 J. M. Mendoza* (type in Philip. Nat. Herb.), September 8, 1933, on the ground; *Bur. Sci. 55116 J. M. Mendoza,* July 29, 1933, on the ground; *Bur. Sci. 55125 P. S. Gener,* August 20, 1933, on the ground; *Bur. Sci. 55149 J. M. Mendoza,* July 10, 1933, on the ground; *Bur. Sci. 55160 J. M. Mendoza,* July 2, 1933, on the ground; *Bur. Sci. 55585 P. S. Gener,* October 16, 1933, on the ground.

The above-examined specimens are similar to *Lepiota procera* from the United States and one specimen from Hungary in general appearance, in form, and in the color and arrangement of scales. The two extra-Philippine species, however, are very much larger. *Lepiota procera* differs largely from the present species in having the spores and the basidia much larger; the former are 10.5 to 15.0 μ long and 8.4 to 11.4 μ broad (Plate 1, fig. 3), and the latter 30.0 to 36.0 μ long and 9.9 to 12.0 μ broad.

2. LEPIOTA CEPAESTIPES Fries. Plate 2.

Lepiota cepaestipes FRIES in Epicrisis (1836) 17; BERKELEY & BROOME, Journ. Linn. Soc. **19** (1871) 499; SACC., Syll. Fung. **5** (1887) 43; COOKE, Hdbk. of Australian Fung. (1892) 9; MASSEE, Brit. Fungus-Flora **3** (1893) 246; GRAFF, Philip. Journ. Sci. **19** (1914) 243; KAUFFMAN, Agaricaceae of Mich. **1** (1918) 640; REA, Brit. Basidiomycetae (1922) 74; RAMSBOTTOM, Hdbk. Larger Brit. Fung. (1923) 30; MENDOZA & LEUS-PALO, Philip. Journ. Sci. **58** (1935) 496; KRIEGER, N. Y. Ste. Mus. Hdbk. **11** (1935) 371.

Lepiota manilensis COPELAND in Bur. Govt. Lab. Publ. **28** (1905) 145.

Pileus 3 to 9 cm in diameter; white or yellowish; mealy or covered with yellowish, floccose or wartlike scales; umbonate, oval, then campanulate-expanded; obtuse, soft, fleshy, striated on margin, splitting in age. Stem white, pale brown in early or late part of mushroom season, otherwise of same color as cap; base bulbous, somewhat ventricose, tapering upward and occasionally covered with floccose particles, hollow, 5 to 14 cm long, 5.0 to 8.0 mm thick at apex. Annulus thin, membranaceous, somewhat persistent. Gills free, thin, narrow, at length remote; edge pruinose. Spores elliptic to ovate, hyaline, granular, guttulate, smooth-walled, varying in size from 8.4 to 12.0 μ long, 6.0 to 9.0 μ broad; average 10.0 μ long, 7.0 μ broad. Basidia clavate, 29.0 to 46.0 μ long, 11.4 to 13.5 μ broad; average 30.0 μ long, 12.7 μ broad.

Growing in tufts on decayed leaves under trees and very common during the wet season, from May or April, although occasionally found in February when the rainy season is prolonged.

LUZON, Laguna Province, Los Baños, *Philip. Nat. Herb. 2094 J. M. Mendoza,* October, 1932; Mount Maquiling, *Bur. Sci. 55671 J. M. Mendoza,* December 23, 1932, on the ground; Manila, *Philip. Nat. Herb. 519 Jesus Conosa,* January 15, 1934, on the ground; *Philip. Nat. Herb. 2540 B. Reyes,* July 24, 1935; *Philip. Nat. Herb. 2544 P. S. Gener,* July 11, 1935, on the ground; *Bur. Sci. 21325 P. W. Graff* (*Lepiota manilensis* Copel. as determined by Graff), July 30, 1913; *Bur. Sci. 50495 S. Leus,* June 21, 1928, on the ground; *Bur. Sci. 50496 B. Reyes,* August, 1928, on the ground; *Bur. Sci. 55056 J. M. Mendoza,* July 8, 1933, on the ground; *Bur. Sci. 55117 J. M. Mendoza,* August 1, 1933, on the ground; *Bur. Sci. 55121 J. M. Mendoza,* July 22, 1933, on the ground; *Bur. Sci. 55122, 55123, and 55127 P. S. Gener,* September 20, 1933, on the ground; *Bur. Sci. 55135 and 55142, J. M. Mendoza,* July 10, 1933, on the ground; *Bur. Sci. 55147 J. M. Mendoza,* June 29, 1933, on the ground; *Bur. Sci. 55157, 55158, and 55161, J. M. Mendoza,* July 11, 1933, on the ground; *Bur. Sci. 55207 J. M. Mendoza,* July 26, 1933, on the ground; *Bur. Sci. 55296 D. Farol,* June 3, 1933; *Bur. Sci. 55602 P. S. Gener,* October 12, 1932, on the ground; *Bur. Sci. 55611 J. M. Mendoza,* September 19, 1933; *Bur. Sci. 55667 J. M. Mendoza,* June 22, 1933, on the ground; *Bur. Sci. 55758 J. M. Mendoza,* February 21, 1933, on the ground; *Bur. Sci. 55769 and 55771 P. S. Gener,* November 7, 1933, on the ground; *Bur. Sci. 55770 P. S. Gener,* November 8, 1933, on the ground; *Bur. Sci. 55824 P. S. Gener,*

October 13, 1933; *Bur. Sci. 55874 J. M. Mendoza,* October 2, 1932, on the ground; *Bur. Sci. 55915 P. S. Gener,* December 20, 1933, on the ground: Rizal Province, Pasay, *Bur. Sci. 55146 J. M. Mendoza,* July 7, 1933, on the ground; *Bur. Sci. 55151 J. M. Mendoza,* July 29, 1933, on the ground; *Bur. Sci. 55553 J. M. Mendoza,* May 20, 1933; *Bur. Sci. 55670 J. M. Mendoza,* May 23, 1932; *Bur. Sci. 55727 J. M. Mendoza,* June 17, 1933, on the ground: Tayabas Province, Atimonan, *Bur. Sci. 55105 J. M. Mendoza,* June 22, 1933, on the ground; *Bur. Sci. 55144 J. M. Mendoza.*

All the above Philippine specimens were found identical in their characters with the United States collection of Edward C. Valkart, Cincinnati, Ohio, September 5, 1922 (New York Botanical Garden, Mycological Herbarium). Copeland's specimen, *Lepiota manilensis,* tallies in all characteristics with *Lepiota cepaestipes* Fries.

3. LEPIOTA MORGANI Peck. Plate 3.

Lepiota morgani PECK in Bot. Gaz. 4 (1879) 157; SACC., Syll. Fung. 5 (1887) 31; HARD, Mushrooms (1908) 50; ATKINSON, Mushrooms (1911) 80; KAUFFMAN, The Agaricaceae of Mich. 1 (1918) 644; McDOUGALL, Mushrooms (1925) 63; KRIEGER, N. Y. Ste. Mush. Hdbk. 11 (1935) 373.

Lepiota chlorospora COPELAND in Ann. Myc. 3 (1905) 28; Bur. Govt. Lab. Publ. 28 (1905) 145; BROWN, Minor Philip. Forest Products 3 (1921) 140.

Pileus 9 to 30 cm in diameter, at first nearly globose, soon becoming expanded, seldom depressed in middle, generally white, covered by a brown cuticle which breaks up into scales except at center, when bruised color changing to brownish, then to yellowish. Gills crowded, free, separated by a white collar from stem; at first white, soon becoming green or greenish. Stem 7 to 9 cm long, 5 to 9 mm wide, white or nearly so, tinged with brown; smooth, firm, cylindrical, swollen at base, sometimes tapering slightly upward. Annulus broad, conspicuous, fixed, persistent; at first white, later discolored by mass of green spores. Basidia clavate, granular, 24.0 to 30.0 μ long, 9.6 to 12.0 μ broad. Spores in mass green, becoming yellowish in age, hyaline-green under microscope, 9.0 to 9.6 μ long, 6.0 to 6.6 μ broad.

LUZON, Bataan Province, Lamao, *Bur. Sci. 55115, J. M. Mendoza,* September 10, 1933, on heavily fertilized sandy soil; *Bur. Sci. 55138 J. M. Mendoza,* September 12, 1933, on the ground; *Bur. Sci. 55859 J. M. Mendoza,* September 11, 1933, on the

ground; *Bur. Sci. 55892 J. M. Mendoza,* September 11, 1933, on sandy soil near beach: Laguna Province, *Bur. Sci. 55601 J. M. Mendoza,* December 9, 1932, on the ground; Agricultural College, *Bur. Sci. 55615 J. M. Mendoza,* July 21, 1932, on the ground; Los Baños, *Bur. Sci. 55790 E. Roldan,* July 14, 1932, on the ground; *Bur. Sci. 55796 E. Roldan,* August, 1931, on the ground; Manila, *Bur. Sci. (no number) E. R. Schreiner,* August 27, 1914 (This specimen according to Copeland is *Lepiota chlorospora*); *Philip. Nat. Herb. 508 P. S. Gener,* July 29, 1933, on the ground; *Philip. Nat. Herb. 526 and 527 P. S. Gener,* August 9, 1934, on the ground; *Philip. Nat. Herb. 1273 P. S. Gener,* May 21, 1934, on the ground; *Philip. Nat. Herb. 2413 P. S. Gener,* May 16, 1935, on the ground; *Bur. Sci. 45176 Father Sanchez,* May, 1935; *Bur. Sci. 50497 C. J. Humphrey,* November, 1926, on the ground; *Bur. Sci. 50546 Father Sanchez,* July 28, 1926; *Bur. Sci. 55091 P. S. Gener,* July 20, 1933, on the ground; *Bur. Sci. 55092 J. M. Mendoza,* September 21, 1933, on the ground; *Bur. Sci. 55124 P. S. Gener,* September 23, 1933, on the ground; *Bur. Sci. 55148 P. S. Gener,* September 18, 1933, on the ground; *Bur. Sci. 55204 J. M. Mendoza,* July 26, 1933, on the ground; *Bur. Sci. 55614 P. S. Gener,* September 16, 1933, on the ground; *Bur. Sci. 55669 H. S. Yates,* June 17, 1917, on the ground; *Bur. Sci. 55770 and 55843 P. S. Gener,* November 7, 1933, on the ground: Rizal Province, San Francisco del Monte, *Bur. Sci. 55668 J. M. Mendoza,* June 15, 1933, on the ground; San Juan, *Philip. Nat. Herb. 2422 F. Franco,* May 29, 1933, on horse manure; San Pedro Makati, *Bur. Sci. 55104 J. M. Mendoza,* September 12, 1932, on the ground; *Bur. Sci. 55120 J. M. Mendoza,* September 13, 1933, on the ground; *Bur. Sci. 55633 J. M. Mendoza,* September 12, 1932, on the ground; *Bur. Sci. 55666 E. Karganilla,* July 28, 1933, on the ground: Tayabas Province, Atimonan, *Bur. Sci. 55102 J. M. Mendoza,* June 22, 1933; Calauag, *Bur. Sci. 50742 Philip. Health Service Officer,* August 8, 1931, on the ground.

The above specimens are identical in their characters with *Lepiota morgani,* a collection of W. E. Broadway, St. George's, August 24, 1905, Plants of Granada, West Indies (New York Botanic Gardens, Mycological Herbarium).

The most outstanding feature of *Lepiota morgani* Peck (*Lepiota chlorospora* Copel.,) is that the spores at maturity become greenish in mass. *Lepiota chlorospora* is doubtless *Lepiota morgani* Peck, so that the former becomes a synonym of the latter.

4. **LEPIOTA AMERICANA** Peck. Plate 4, fig. 1.

Lepiota americana PECK in N. Y. Ste. Cab. Rept. **23** (1872) 71; SACC., Syll. Fung. **5** (1887) 43; ATKINSON, Mushrooms (1911) 80; MURRILL, Mycologia **3** (1911) 168; KAUFFMANN, The Agaricaceae of Mich. **1** (1918) 648; GRAHAM, Chicago Acad. Sciences **4** (1933) 48; MENDOZA & LEUS-PALO, Philip. Journ. Sci. **53** (1934) 223; KRIEGER, N. Y. Ste. Mus. Hdbk. **11** (1935) 370.

Agaricus boltoni COPELAND in Bur. Govt. Lab. Publ. **28** (1905) 144; BROWN, Minor Philip. Forest Products **3** (1921) 132.

Pileus 5 to 14 cm in diameter; white, becoming dark brown on maturity; convex, conical, umbonate to subumbonate at maturity, cuticle at first reddish brown, soon breaking into scales except at umbo; scales scattered, appressed; margin striate, laciniate, when bruised entire plant turning pinkish to reddish brown. Gills free, white, broad, 7 to 9 mm wide. Stipe hollow, white, becoming brown in age, enlarged at base, slender above ring, 7 to 10 mm in diameter. Annulus broad, very conspicuous, 1.3 to 2.2 cm wide, 1.6 to 2.5 cm from pileus. Basidia clavate, bearing 4 slender sterigmata, 18 to 30 μ long, 8.4 to 10.5 μ broad; average 24.5 μ long, 9.1 μ wide. Spores subellipsoid, guttulate, smooth, hyaline, 8.5 to 10.5 μ long, 5.0 to 7.2 μ broad; average 9.9 μ long, 6.25 μ broad.

LUZON, Manila, *Philip. Nat. Herb. 1289 P. S. Gener,* May 21, 1934, on the ground; *Philip. Nat. Herb. 1304 P. S. Gener,* June 14, 1934, on the ground; Pandacan, *Philip. Nat. Herb. 517 P. S. Gener & B. Reyes,* October 28, 1933, on the ground; *Philip. Nat. Herb. 1334 P. S. Gener & F. B. Sangalang,* June 2, 1933, on the ground; *Philip. Nat. Herb. 1896 P. S. Gener,* July 26, 1934, on the ground; *Bur. Sci. 55119 J. M. Mendoza,* July 29, 1933, on the ground; *Bur. Sci. 55137 and 55139 J. M. Mendoza,* July 24, 1933, on the ground; *Bur. Sci. 55209 J. M. Mendoza,* July 25, 1933, on the ground; *Bur. Sci. 55587 J. M. Mendoza,* August 1, 1933, on the ground; *Bur. Sci. 55735 J. M. Mendoza,* February 2, 1933, on the ground; *Bur. Sci. 55768 and 55842 P. S. Gener,* November 7, 1933, on the ground. MINDANAO, Davao Province, *E. B. Copeland 433,* April, 1904 (type collection of *A. boltoni* Copel. in Philip. Nat. Herb.).

In shape this species resembles a poisonous species, *L. morgani* Peck., particularly in the button stage. *Lepiota morgani,* however, has green spores, making the gills look greenish.

The examined specimens are identical in their characters with a United States collection of Miss D. Levy, vicinity of New York (New York Botanical Garden, Mycological Herbarium).

In the type collection of *Agaricus boltoni* Copel. the spores are white and subellipsoid. The presence of the white spores alone eliminates this species from the genus *Agaricus*, which is a purple-brown agaric. The distinctive shape and size of the spores which agree closely with those of *Lepiota americana* lead us to consider that these two species are the same. Another feature which confirms that *Agaricus boltoni* is *Lepiota americana* is the bulbous base of the former, which character is not lost even in the dried specimen.

5. LEPIOTA CRISTATA Fries. Plate 4, fig. 2.

Lepiota cristata FRIES in Syst. Myc. (1821) 22; Hym. Eur. (1874) 32–33; SACC., Syll. Fung. 5 (1887) 39; MASSEE, Brit. Fungus-Flora 3 (1893) 242; ATKINSON, Mushrooms (1911) 81; KAUFFMAN, The Agaricaceae of Mich. 1 (1918) 641; REA, Brit. Basidiomycetae (1922) 71; RAMSBOTTOM, Hdbk. Larger Brit. Fung. (1923) 30; McDOUGALL, Mushrooms (1925) 65; MAUBLANC, Les Champ. Com. et Ven. (1926) 16; BRES., Icon. Mycol. 1 (1927) 34; SWANTON, Fung. and How to Know Them (1932) 177, 178.

Lepiota fusco-squamea PECK in Rep. Ste. Mus. 5 (1873) 50; SACC., Syll. Fung. 5 (1887) 201; BROWN, Minor Philip. Forest Products 3 (1921) 140.

Pileus 3 to 6 cm in diameter, fleshy, silky, campanulate, then expanded, often umbonate; disc brown, covered with reddish-brown scales. Gills 3 to 5 cm long, 2 to 6 cm in diameter; white, plane, narrow, crowded, free toward center. Stipe fragile; white or yellowish below ring; hollow or stuffed; glabrous or silky fibrillose. Annulus narrow, somewhat membranaceous, distant, white, often tinged reddish, fugacious, disappearing. Gills free, plane, white, crowded. Spores hyaline, reniform, obliquely apiculate, 8.4 to 10.5 μ long, 3.3 to 5.4 μ broad. Basidia clavate, 16.5 to 19.5 μ long, 4.5 to 5.4 μ broad.

LUZON, Laguna Province, Los Baños, *Bur. Sci. 55635 J. M. Mendoza,* December 10, 1932, on the ground: Manila, *Philip. Nat. Herb. 1281 P. S. Gener,* May 25, 1934, on the ground; *Philip. Nat. Herb. 1284 P. S. Gener,* May 31, 1934, on the ground; *Philip. Nat. Herb. 1291 P. S. Gener,* May 22, 1934, on the ground; *Philip. Nat. Herb. 1299 P. S. Gener,* May 24, 1934, on the ground; *Philip. Nat. Herb. 2435 P. S. Gener,* June 1, 1935, on the ground; *Bur. Sci. 9170 E. D. Merrill,* July 24, 1913; *Bur. Sci. 55145 J. M. Mendoza,* July 6, 1933, on the ground; *Bur. Sci. 55730 J. M. Mendoza,* August 12, 1933, on the ground: Rizal Province, Alabang, *Philip. Nat. Herb. 2492 J. M. Mendoza,* July 12, 1935, on the ground.

The distinctive reddish-brown scales of *Lepiota fusco-squamea* Peck, the umbonate character of the pileus, and the diminutive size of this species make it appear a synonym of *Lepiota cristata* Fries. Microscopical examination of spores and basidia of these two species proves that they both fall under the same size variation.

6. **LEPIOTA LILACEA Bresadola. Plate 5, fig. 1.**

Lepiota lilacea BRESADOLA in Sacc., Syll. Fung. 11 (1895) 3; BRES., Icon. Mycol. 1 (1927) 39.

Pileus fleshy, 2 to 4 cm in diameter; convex-campanulate, expanded, depressed at center, sometimes umbonate; at first violet-purple, later discolored; cuticle breaking up into beautiful dark scales. Gills white, somewhat crowded, inflated on one side, round and free toward center, adpressed at fringed edge. Stem hollow, fibrous, somewhat covered with powdery scales, becoming smooth, white, flesh-colored to violet, 3 to 5 cm long, 3 to 5 mm in diameter. Annulus membranaceous, inferior, persistent, white above, dark violet below. Flesh white, odorless, tasteless. Spores hyaline, elliptic, 6.0 to 6.6 μ long, 3 to 3.6 μ broad. Basidia clavate, 21 to 24 μ long, 6.6 to 9 μ broad.

LUZON, Laguna Province, Los Baños, *Philip. Nat. Herb. 2078 and 2093 J. M. Mendoza,* December, 1932: Manila, *Philip. Nat. Herb. 509 P. S. Gener,* February 3, 1934; *Philip. Nat. Herb. 1267 P. S. Gener,* January 17, 1934, on the ground; *Philip. Nat. Herb. 1282 P. S. Gener,* May 23, 1934, on the ground; *Bur. Sci. 55118 P. S. Gener,* September 23, 1933, on the ground; *Bur. Sci. 55563 P. S. Gener,* October 9, 1933, on the ground; *Bur. Sci. 55845 P. S. Gener,* November 8, 1933, on the ground; *Bur Sci. 55917 P. S. Gener,* December 16, 1933, on the ground; *Bur. Sci. 55926 P. S. Gener,* December 21, 1933, on the ground: Rizal Province, Alabang, *Philip. Nat. Herb. 2526 J. M. Mendoza,* July 24, 1935, on the ground under acacia, *Samanea saman* (Jacq.) Merr.

7. **LEPIOTA CANDIDA Copeland. Plate 5, fig. 2.**

Lepiota candida COPELAND (not *L. candida* Morgan) in Bur. Govt. Lab. Publ. 28 (1905) 146; BROWN, Minor Philip. Forest Products 3 (1921) 202.

Lepiota pulcherrima (Morg.) GRAFF in Philip. Journ. Sci. 9 (1914) 244.

Pileus at first ovate, then conical, umbonate, flat in age; snow white, 4.0 to 5.0 cm in diameter; when young covered with fine to coarse scales, soon disappearing. Stipe 9 to 10 cm long, 5.0

to 7.0 mm in diameter; same color as pileus; covered with evanescent scales; cylindric, not bulbous, gradually tapering into narrower diameter as it approaches pileus. Annulus white, floccose, thin, high up, early disappearing. Gills free, thin, white, crowded, close, nearly acute at both ends. Flesh white, odorless; taste mild. Spores elliptical, cylindrically apiculate at one end, with a pinkish tinge at a certain focus of the microscope; 7.5 to 9.6 μ long, 5.4 to 6.5 μ broad. Basidia clavate, 15.0 to 18.0 μ long, 3.6 to 5.1 μ broad.

LUZON, Bataan Province, Lamao, *Bur. Sci. 55903 J. M. Mendoza,* September 11, 1933, on the ground: Manila, *Bur. Sci. 56 Father Sanchez,* September, 1913 [type collection of *Lepiota pulcherrima* (Morg.) Graff in Philip. Nat. Herb.]; *Philip. Nat. Herb. 1322 and 1339 P. S. Gener,* May 24, 1934, on the ground; *Philip. Nat. Herb. 1324 P. S. Gener,* May 22, 1934, on the ground; *Philip. Nat. Herb. 2382 P. S. Gener,* May 16, 1935, on the ground; *Phil. Nat. Herb. 2521 T. G. Fajardo,* July 17, 1935, on adobe wall; *Bur. Sci. 25386 H. S. Yates,* June 27, 1916, on decaying leaves and twigs; *Bur. Sci. 55176 J. M. Mendoza,* September 12, 1933, on the ground: Rizal Province, Pasay, *Philip. Nat. Herb. 2591 Bureau of Health Officer,* May 23, 1934, on the ground: Tayabas Province, Atimonan, *Bur. Sci. 55156 J. M. Mendoza,* June 23, 1933, on the ground.

The white appearance is the most striking character of *Lepiota candida* Copel. and *Lepiota pulcherrima* (Morg.) Graff. The characteristic fusiform lower third of the stipe, however, and the spore measurements of these two species show that they are synonymous. Copeland was first to describe this species; the name he gave to it is very descriptive of the fungus, and we retain it in this paper, leaving *Lepiota pulcherrima* (Morg.) Graff as a synonym.

8. LEPIOTA DENUNDATA Rabenhorst. Plate 6, fig. 1.

Lepiota denundata RABENHORST in Exs. (1853) 1006; FR., Hym. Eur. (1874) 38; SACC., Syll. Fung. 5 (1887) 52; BRES., Icon. Mycol. 1 (1927) 40.

Lepiota sulphopenita GRAFF, Philip. Journ. Sci. 9 (1914) 245.

Pileus globose to conical when young, becoming campanulate to broadly expanded; generally sulphur-yellow throughout; thin, fleshy, 4 to 7 cm in diameter; sometimes center of cap mealy orange, covered with fine floccose scales which disappear in age; margin deeply striated especially when old. Gills free, thin, narrow, few, white, becoming yellowish because of scales from the cap adhering to them. Stem hollow, floccose, cylin-

drical, elongated at base, sulphur-yellow, 7 to 10 cm long, 6 to 11 mm broad. Annulus thin and early disappearing. Spores ovate-elliptic, hyaline, guttulate, smooth-walled, 7.5 to 9.6 µ long, 5.4 to 6.3 µ broad. Basidia clavate, granular, 15 to 18.6 µ long, 3.6 to 4.5 µ broad.

LUZON, Bataan Province, Lamao, *Bur. Sci. 55732 J. M. Mendoza,* September 10, 1933, on the ground: Manila, *Philip. Nat. Herb. 1283 P. S. Gener,* May 28, 1934, on disintegrated trunk of palms; *Philip. Nat. Herb. 2017 P. S. Gener,* September 12, 1934, on the trunk of a living tree; *Philip. Nat. Herb. 2381 P. S. Gener,* May 13, 1935; *Philip. Nat. Herb. 2542 P. S. Gener,* July 23, 1935, on the ground; *Bur. Sci. 8417 E. D. Merrill,* August 18, 1912 (type collection of *Lepiota sulphopenita* Graff in Philip. Nat. Herb.); *Bur. Sci. 55825 J. M. Mendoza,* August 31, 1933, on the ground; *Bur. Sci. 55826 P. S. Gener,* October 8, 1933, on the ground: Rizal Province, Pasay, *Philip. Nat. Herb. 1547 Bur. of Health,* May 23, 1934, on disintegrated wood; Harrison Park, *Philip. Nat. Herb. 2121 Bur. of Health Officer,* May 23, 1934, on ground: Tayabas Province, Atimonan, *Bur. Sci. 55140 J. M. Mendoza,* June 23, 1933, on the ground.

Our studies on the two fungi show that *Lepiota denundata* and *L. sulphopenita* are identical in their characters and probably the same species. The sulphur-yellow color of the entire fungus and the campanulate pileus are the characteristics common in the two species. Spores and basidia are also alike. The difference in size, *L. denundata* Rabenh. being smaller than *L. sulphopenita* Graff, does not warrant calling the latter fungus a new species, as environment and nature of compost where a fungus grows may affect its size.

9. LEPIOTA METULISPORA Berkeley and Broome. Plate 6, fig. 2.

Lepiota metulispora BERKELEY & BROOME in Journ. Linn. Soc. 11 (1871) 512; FR., Hym. Eur. (1874) 32; SACC., Syll. Fung. 5 (1887) 38; MORGAN, Journ. Myc. 12 (1906) 198; BRES., Icon. Mycol. 1 (1927) 40.

Pileus 4 to 7 cm in diameter; fleshy, campanulate-expanded, swollen to broadly umbonate, covered with lemon-yellow to tawny-colored scales; center smooth. Gills white, crowded, free, rounded toward the stem, close. Stem 4 to 9 cm long, 5 to 9 mm in diameter, hollow, white, covered below ring with tawny to lemon-colored scales. Annulus cottony, later disappearing. Flesh white like that of pileus, a little darker, of fungous odor and mild taste. Spores hyaline, elongated, flexuous, 15.6 to

18.0 μ long, 4.5 to 5.7 μ broad. Basidia clavate, 18.0 to 21.0 μ long, 6.0 to 8.4 μ broad.

LUZON, Manila, *Philip. Nat. Herb. 1344 Jesus Conosa,* February 12, 1934; *Philip. Nat. Herb. 2042 P. S. Gener,* September 6, 1934, on the ground; *Philip Nat. Herb. 2433,* June 1, 1935, on the ground; *Philip. Nat. Herb. 2488 P. S. Gener,* July 3, 1935, on the ground; *Philip. Nat. Herb. 2520 P. S. Gener,* July 10, 1935, on the ground; *Philip. Nat. Herb. 2538 P. S. Gener,* July 5, 1935, on the ground; *Philip. Nat. Herb. 2541 P. S. Gener,* July 23, 1935.

10. LEPIOTA HISPIDA Lasch. Plate 7, fig. 1.

Lepiota hispida LASCH in Fr., Hym. Eur. (1874) 32; SACC., Syll. Fung. 5 (1887) 36; MASSEE, Brit. Fungus-Flora 3 (1893) 240; REA, Brit. Basidiomycetae (1922) 67, 68; RAMSBOTTOM, Hdbk. Larger Brit. Fung. (1923) 30; BRES., Icon. Mycol. 1 (1927) 28.

Pileus 3 to 8 cm in diameter; soft, fleshy; chestnut-brown to brown; hemispherical, then expanded, umbonate; covered with shaggy scales which are denser at center than around margin. Stem 4 to 9 cm long, 4 to 12 mm in diameter, cylindrical, more or less bulbous at base, tapering upward, scaly, of same color as pileus. Annulus broad, superior, white-rose above, tawny below, striated. Gills white, crowded, free toward the stem, linear, branched, often veined. Flesh white, thin; of mushroom odor, no taste. Spores hyaline, elliptic, 6 to 7 μ long, 2 to 3 μ broad. Basidia clavate, 25 to 28 μ long, 6 to 7 μ broad.

LUZON, Mountain Province, Haights' Place, *Philip. Nat. Herb. 2008 C. J. Humphrey,* May 4, 1935, on dead log.

11. LEPIOTA MELEAGRIS Sowerby. Plate 7, fig. 2.

Lepiota meleagris SOWERBY in Fr., Hym. Eur. (1874) 31; SACC., Syll. Fung. 5 (1877) 30; MASSEE, Brit. Fungus-Flora 3 (1893) 239; REA, Brit. Basidiomycetae (1922) 68; RAMSBOTTOM, Hdbk. Larger Brit. Fung. (1923) 29; BRES., Icon. Myc. 1 (1927) 29.

Pileus fleshy, conical-campanulate when young, becoming umbonate when expanded; 1 to 3 cm in diameter; fawn-colored, covered with minute brownish scales; margin becoming smooth. Gills crowded, white to flesh-colored, becoming reddish on rubbing or drying; free and round toward stem, separated from stem, with a cartilaginous collar. Stem stuffed, of same color as pileus, here and there tinged with yellow, covered with minute scales below ring, spindlelike or tapering upward from bulbous base. Ring white, easily disappearing, outside often covered with minute blackish scales. Flesh white, tawny red when

bruised or dried, odor unpleasant, taste agreeable. Spores elliptic, obliquely apiculate, 6.6 to 8.4 μ long, 3 to 3.6 μ broad. Basidia clavate, 13.5 to 15 μ long, 3.9 to 4.5 μ broad.

LUZON, Laguna Province, Agricultural College, *Bur. Sci. 55764 J. M. Mendoza,* December 18, 1932, on the ground.

12. LEPIOTA GRACILENTA Krombholtz. Plate 4, fig. 3.

Lepiota gracilenta KROMBHOLTZ in Fr., Hym. Eur. (1874) 30; SACC., Syll. Fung. 5 (1887) 32; REA, Brit. Basidiomycetae (1922) 66; RAMSBOTTOM, Hdbk. of Larger Brit. Fung. (1923) 29; BRES., Icon. Mycol. 1 (1927) 21.

Lepiota elata COPELAND in Bur. Govt. Lab. Pub. 28 (1905) 146; BROWN, Minor Products of Philip. Forest 3 (1921) 140.

Pileus at first ovate, then campanulate, finally flattened, 6 to 12 cm in diameter, umbonate, whitish, covered with fuscous cuticle, cuticle later breaking up into scales; margin smooth. Stem whitish, covered with fine yellowish scales, gradually tapering upward from a subglobous base, 10 to 15 cm long, 0.5 to 1 cm in diameter. Annulus whitish, cottony, movable, early disappearing. Gills free, separated from stem by a broad cartilaginous ring, very crowded. Flesh white, odor agreeable, taste pleasant. Spores hyaline, subelliptic, 9.6 to 12.0 μ long, 7.5 to 9.0 μ broad. Basidia clavate, 16.0 to 21.0 μ long, 7.5 to 8.4 μ broad. Cystidia bottle-shaped, ventricose, 45.0 to 66.0 μ long, 13.5 to 15.0 μ broad.

LUZON, Manila, *Philip. Nat. Herb. 2417 P. S. Gener,* May 29, 1935, on ground; *Philip. Nat. Herb. 2419 B. Reyes,* May 31, 1935, on ground; *Philip. Nat. Herb. 2489 P. S. Gener,* July 5, 1935, on ground.

We have decided to place *L. elata* Copel. as a synonym to *L. gracilenta* Krombh. because of the following characters: the caps of *L. elata* Copel. and *L. gracilenta* Krombh. are conical at first and remain distinctly umbonate when fully flattened, covered throughout with fine silky scales. In both the gills are white at first becoming wine-colored upon touching. The two species also agree in all microscopic details, as size of spores and basidia.

ACKNOWLEDGMENTS

The writers acknowledge their obligation to the Rev. Francis X. Reardon, S. J., of the Ateneo de Manila, for translating into Latin the diagnoses of the new species; and to the Director of the New York Botanical Garden for the loan of *Lepiota* specimens.

ILLUSTRATIONS

PLATE 1

FIG. 1. *Lepiota philippinensis* Mendoza sp. nov.; × 0.7.
2. Spores of *Lepiota philippinensis* Mendoza sp. nov.; × 450.
3. Spores of *Lepiota procera* Fries; × 450.

PLATE 2

Lepiota cepaestipes Fries; × 0.07.

PLATE 3

Lepiota morgani Peck; × 0.8.

PLATE 4

FIG. 1. *Lepiota americana* Peck; × 0.425.
2. *Lepiota cristata* Peck; × 0.425.
3. *Lepiota gracilenta* Krombholtz; × 0.6.

PLATE 5

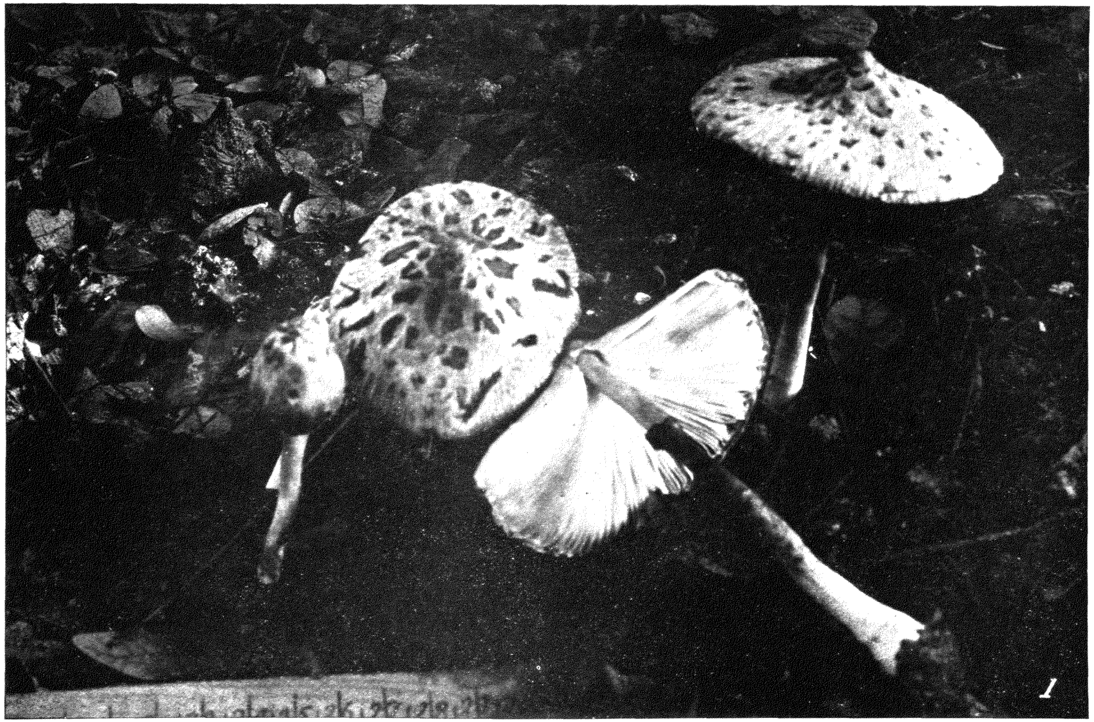
FIG. 1. *Lepiota lilacea* Bresadola; × 0.7.
2. *Lepiota candida* Copeland; × 0.8.

PLATE 6

FIG. 1. *Lepiota denundata* Rabenhorst; × 0.44.
2. *Lepiota metulispora* Berkeley and Broome; × 0.78.

PLATE 7

FIG. 1. *Lepiota hispida* Lasch; × 1.
2. *Lepiota meleagris* Sowerby; × 3.



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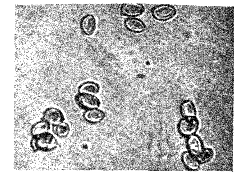

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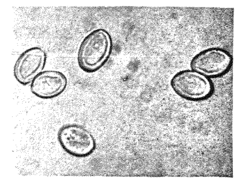

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PLATE 1.

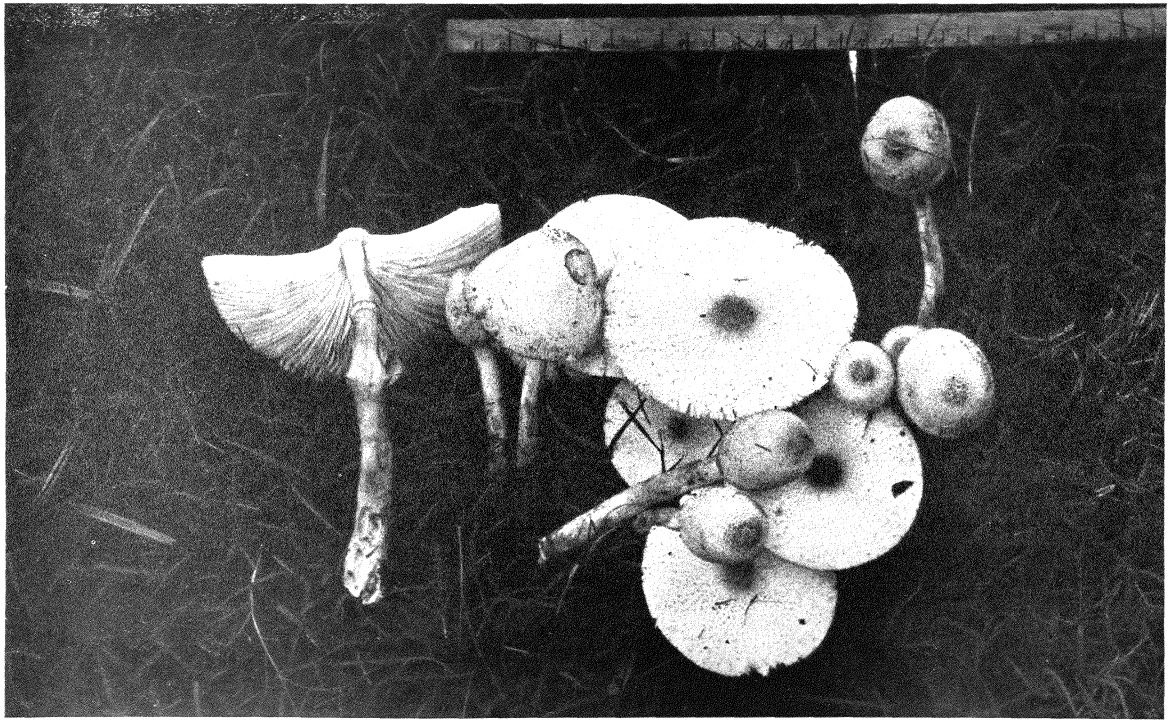


PLATE 2.

PLATE 3.

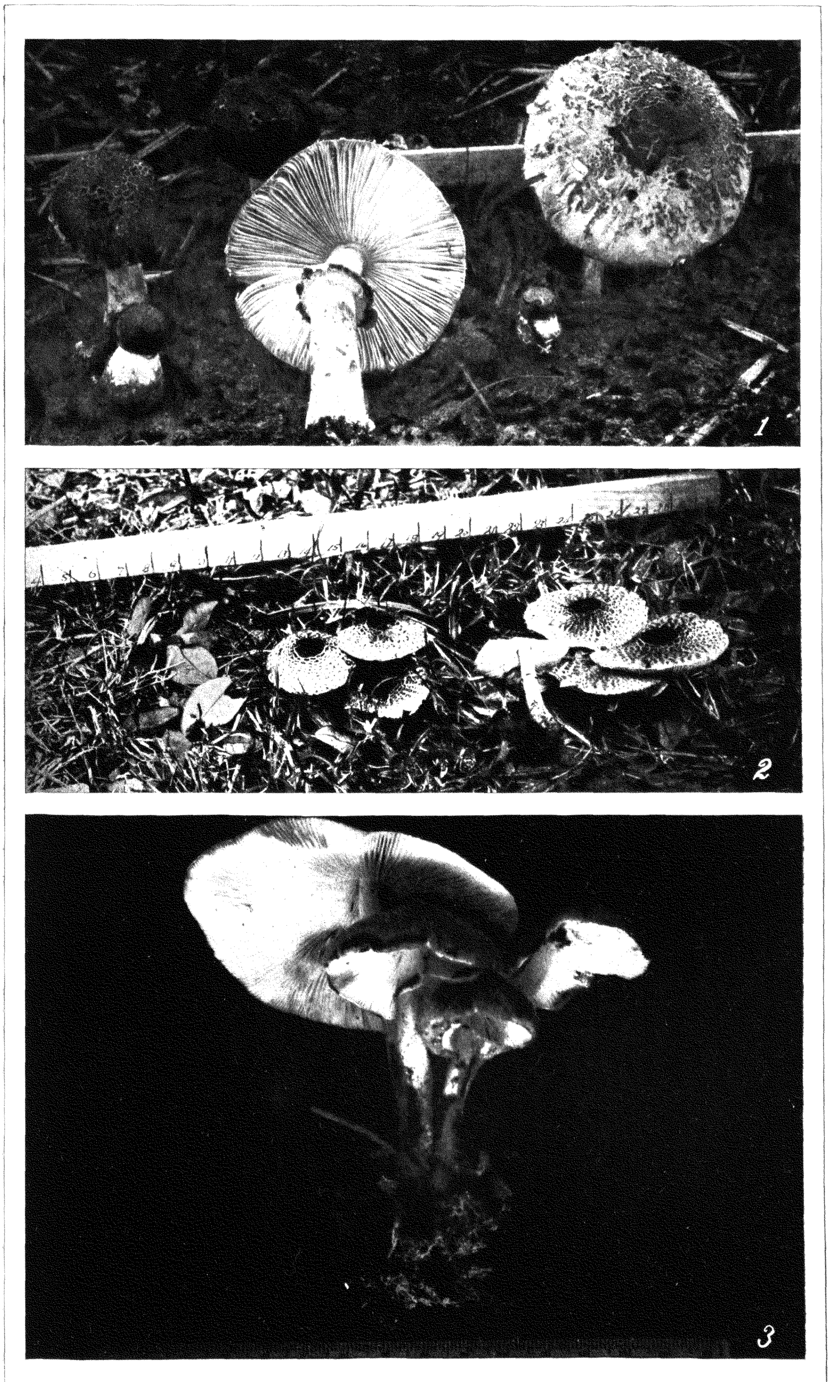


PLATE 4.

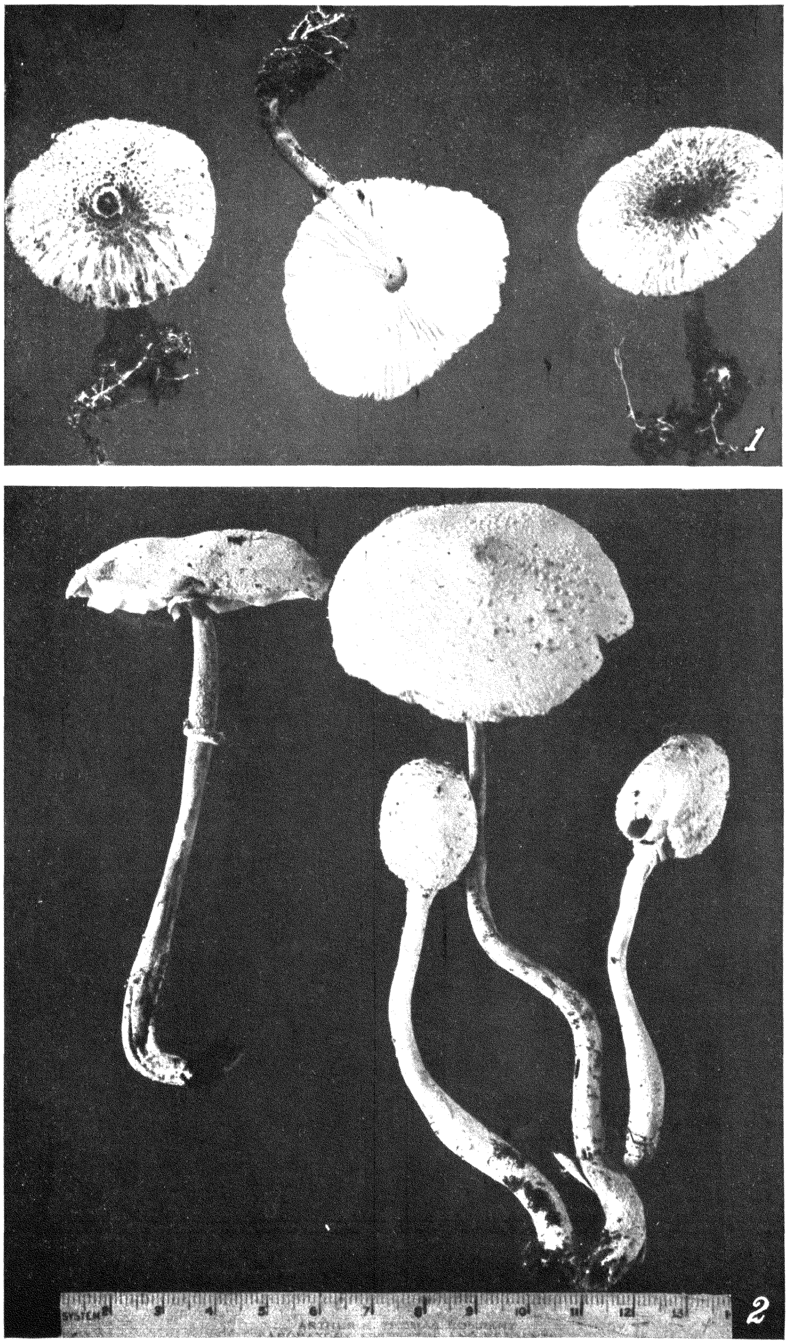


PLATE 5.

PLATE 6.

PLATE 7.

THE DIWAL FISHERY OF OCCIDENTAL NEGROS

By GUILLERMO L. ABLAN

Of the Fish and Game Administration, Bureau of Science, Manila

TWO PLATES

The investigation of the diwal fisheries of Occidental Negros was undertaken in accordance with the industrialization plan of the Bureau of Science. Observations were made during a season of rough weather and heavy rains; consequently, because of unfavorable circumstances, the period of a little more than one month allowed for the study was not fully utilized. This report includes field observations and information obtained from shell diggers, consumers, and government officials regarding the fishery.

The diwal has a limited distribution. The Marayo diwal bed in the jurisdiction of Pontevedra, where this bivalve is most abundant in this locality, was selected for observation. Pontevedra, established about 1877 or 1878, is now a second-class municipality, with a population of 14,000 and an area of 23,178 hectares. It is located along the coast bordering Guimaras Strait, well protected from the west by Panay and Guimaras Islands, and drained by Marayo River which empties into Guimaras Strait. Numerous varieties of shells embedded in the soil are evidence that this place was at one time below sea level.

In gathering information regarding the various factors influencing demand and consumption, local consumers, including diggers and government officials, were interviewed. The diwal is locally considered the most healthful and delicious among the shell foods found in this locality, not excepting the oyster. It is of good flavor, either raw or prepared, and has a large amount of meat compared with other bivalves. Therefore the diwal is in great demand, not only in the local markets but also in other markets of the Philippines.

In this locality four factors, the influence of the incoming sea water passing between points of Sojoton and South, the effect of river discharge, the type of soil, and the location, were studied.

The Marayo diwal bed is located at the mouth of Marayo River, along the coast from Balangigay point on the south approximately 1 kilometer, and to the north about 50 meters, from the mouth of the river. This portion of the shore has been a productive diwal ground for almost half a century. It has an area of approximately 20 hectares, being 1,000 meters long and 200 meters wide.

The salinity of the water decreases between the diwal bed and the mouth of the river. The incoming salt water mixes in this section with the fresh water from the river.

The soil in this section, including adjacent deeper areas, is sticky, soft, fine sand and clay, blanketed with a layer of fine silt. The incoming and outgoing tidal current seem moderate.

In shape the diwal (*Pholas orientalis* Gmelin) (Plate 1, fig. 3), looks more or less like a corncob. The two valves are alike, and are crowned with a loose spoonlike shell with a prominent subanterior nucleus. The valves are laminate with rasplike ribs which radiate in rows from dorsal to ventral. The shell is open at both ends. The interior of the shell is usually whitish. The meat is soft, and, except the rather rough siphon, is edible even raw. The truncate foot is short and large, and can be expanded beyond the valves. The siphon (Plate 1, figs. 1 and 2) is a large, long, cylindrical tube ciliated at the end. It is a sensitive, muscular, and protrusible tubular organ, having two openings, the ventral, through which water containing diatoms, protozoa, and organic matter are drawn in, and the dorsal, through which waste materials are spouted out. The extension of the retracted siphon of the diwal may be induced by pouring water over the anterior side of the foot. Table 1 shows the length of the siphon in two specimens.

TABLE 1.—*Approximate length of siphon of diwal.*

Depth of burrow.	Size of diwal.		Length of siphon, extended.
	Length.	Circumference.	
Inches.	*Inches.*	*Inches.*	*Inches.*
18.5	4.5	4.5	7.5
17.5	4.11	4.5	7.0

After being extracted from its lodge and dropped into the water, the mollusk has never been observed to burrow its way into the ground under water. Diwal placed in a box filled with

soil from the ground of their own habitat were not noticed to burrow.

DISTRIBUTION OF DIWAL IN MARAYO

Diwal in their own habitat live buried, vertically or horizontally, to a depth of from less than a foot to about 2 feet. Table 2 shows the size of a number of burrows found.

TABLE 2.—*Size of burrows of diwal.*

Specimens.	Distance between holes.	Burrow. Position.	Burrow. Depth or length.
	Inches.		*Inches.*
1		Vertical	9.0
1		do	11.5
1		Horizontal	12.0
1		do	17.0
1		do	17.0
2	1	do	19.0
2	8	do	16.0
1		do	21.0
2	7	do	17.0
1		do	22.0
1		do	20.0
14			

Diwal commonly occur singly in a burrow and are revealed by slits or holes which the animals form on the surface of the ground. In cases where they are abundant they sometimes form groups called *pagahan*, similar to the hive nest of the white ants. Digging out such colonies one may include several others, due to the softness of the soil of their habitat.

The irregular distribution of these mollusks in a given bit of ground, where they occur singly or in groups, may be due to biological causes in connection with certain stages of their life history.

METHODS OF GATHERING DIWAL

A digger's outfit consists of (*a*) *usoc*, (*b*) *antipara*, (*c*) *guantes*, (*d*) *pu-yo*, (*e*) *tagad*, and (*f*) *baroto*.

The usoc is a bamboo or wooden pole about 5 or 8 centimeters in diameter and 4 to 5 meters long. It is an indispensable device for the digger to hold on to while working under water or while he is resting on the surface.

The antipara is a pair of water-proof eyeglasses to enable the digger to open his eyes under water, in order to determine

the location of mollusks without subjecting his eyes to undue strain.

The guantes are made of cotton cloth, and fit individual fingers which they protect from sharp shells. They are held firmly at the bases with strong fine cotton twine which keeps them from slipping off.

The pu-yo is ordinarily a sack with a short rope tied to each corner of the opened top. The ropes serve as a belt to hold the sack for the shells.

The tagad is a paddle-shaped implement, of either iron or wood, with which to dig out the mollusk.

The baroto is a dugout used by the digger to go to and from the shell ground.

Whenever possible the diwal is dug with the hands. Where the soil is hard and the water deep, digging out the burrow of the mollusk is somewhat risky and complicated. Good weather and clear water are always necessary. Upon arrival at the ground, the baroto is anchored and the digger drives his usoc into the ground. After the goggles and sack are set, the digger plunges into the water to reach the pole. The pole is thrust into the ground and pulled up several times to test firmness; then the digger, holding the pole, goes down to the bottom feet first, to locate the holes of the mollusks.

Plate 2, figs. 1 and 2, show how the digger rests in relation to the pole and the position of the body during the digging, which mostly depends on the distance of a hole or holes from the pole.

The digger sticks an index finger into a slit, which disturbs the mollusk and causes it to withdraw its siphon and thus to reveal its position. The burrow is then dug out with one or both hands until the shell is reached. The shell is then held firmly between the thumb and the forefinger on both edges of the posterior side, to prevent the valves from breaking. When difficulty is encountered in extracting the shell, a twist is made, followed by a push and pull movement to loosen the mollusk from its burrow. One dive usually lasts about half a minute. The number of shells dug out in one dive depends on the abundance of shells, the types of soil, and the endurance of the digger.

In grounds where the soil is very hard, the tagad is indispensable. As soon as all burrows in one spot are dug out, the pole is moved to another place and the operation repeated.

While digging for diwal, diggers meet water snakes (*walo-walo*), sharks (*baguis*), and jelly fishes (*pitres*). The sting of

Medusæ of many varieties, kinds, forms, and sizes inflict severe pain which, in some cases, even results in illness. Their habit of drifting with the tide makes them a frequent menace to diggers. A victim from jellyfish sting is usually made to perspire profusely by placing him over steaming sea water and covering him with a thick blanket.

Water snakes and sharks, which are sometimes found in the locality, are enemies of the diwal, whose siphons if extended within the reach of the snakes or fish are lost.

STATUS OF THE DIWAL FISHERIES

A diwal bed has always served as a communal fishery ground open to all, a condition which has prevailed for about half a century, since the foundation of the municipality. Such an arrangement has attracted diggers from other localities to Pontevedra to take advantage of this fishery resource. There are no regulatory measures for the conservation of the species, and the digger may fish at all times, and collect and gather any size and any quantity of shells, and may use any device for digging.

There are no available records regarding the quantity and the value of this fishery resource. Diggers interviewed said that the diwal season is from March to the early part of June every year, and that the harvest from this bed was most abundant from 1926 to 1928. In those years each digger could gather not less than 500 shells daily, and there were as many as 50 diggers a day. The total daily collection of 25,000 shells, which were sold at 1.50 pesos[1] a hundred, would give a daily sale of 375 pesos. The annual harvest during this period on the basis of three months' operation was estimated at 33,750 pesos. Since then it has declined, until the present harvest is estimated to be around 8,000 pesos annually, which is only one-fourth that of the years of abundance.

MARKETING OF THE DIWAL

Diwals are marketed alive. In transporting them by trucks or sailing sampans, great care is always taken to keep them alive until they reach the market.

It has been found that shells placed in boxes filled with soil from the diwal ground kept moist with salt water can live for about 4 days.

[1] One peso is equal to 50 cents United States currency.

Because of their high value in the locality and in other islands only a small portion of the shells gathered are sold for local consumption.

The diwal compared with other shells is meaty, and its meat is of a rich milky quality, which makes diwal soup rich and delicious. Table 3 shows the size and weight of 6 specimens.

TABLE 3.—*Size and weight of diwal.*

Specimen.	Shell.		Greatest thickness of body.	Weight.				
	Length.	Width.		Specimen.	Shell.		Meat.	
	cm.	*cm.*	*cm.*	*g.*	*g.*	*Per cent.*	*g.*	*Per cent.*
1	10.2	3.3	3.6	40.64	17.11	42	23.53	57
2	12.7	3.85	4.0	67.48	23.55	34	43.93	66
3	13.0	3.8	3.9	70.85	22.42	31	48.43	68
4	13.2	3.9	3.8	56.59	17.93	31	38.66	68
5	13.3	3.9	4.0	74.27	22.81	30	51.46	69
6	13.8	3.6	3.8	78.38	23.36	29	55.02	70
Total				388.21	127.18	197	261.03	398
Average				64.73	21.03	33	43.64	66

Table 3 shows that approximately 66 per cent of the mollusk is edible meat.

CONSERVATION OF THE DIWAL

The supply of diwal tends to diminish. Growing communities with increasing populations and industrial plants, such as sugar centrals and rice mills, which are close to Marayo River and its tributaries, are positive factors in bringing about depletion of the fishery if the latter remains unprotected.

For the protection and conservation of the diwal, which has a wide reputation in Philippine markets, methods of harvesting it and minimum size and quantity of shells taken should be established.

The effects of water pollution on any aquatic life, although of temporary nature, cannot be overestimated. Consequently, steps should be taken to safeguard the streams from any source of pollution, especially from Sugar Centrals. Conservation in the positive sense implies wise utilization without endangering the future supply.

The first attempt to transplant diwal was undertaken in connection with this investigation. About one hundred diwal shells were brought to Hinigaran Fish Farm August 15, 1937.

The shells were planted by burying less than a foot deep in the soft sticky mud on the river side. About a week later most of the diwal were found to be alive.

ILLUSTRATIONS

PLATE 1

FIG. 1. *Pholas orientalis* (side view).
2. *Pholas orientalis* (open view).
3. *Pholas orientalis* (dorsal view).
4. *Pholas orientalis* (ventral view).

PLATE 2

FIG. 1. Digging of *Pholas orientalis* (one position).
2. Digging of *Pholas orientalis* (another position).

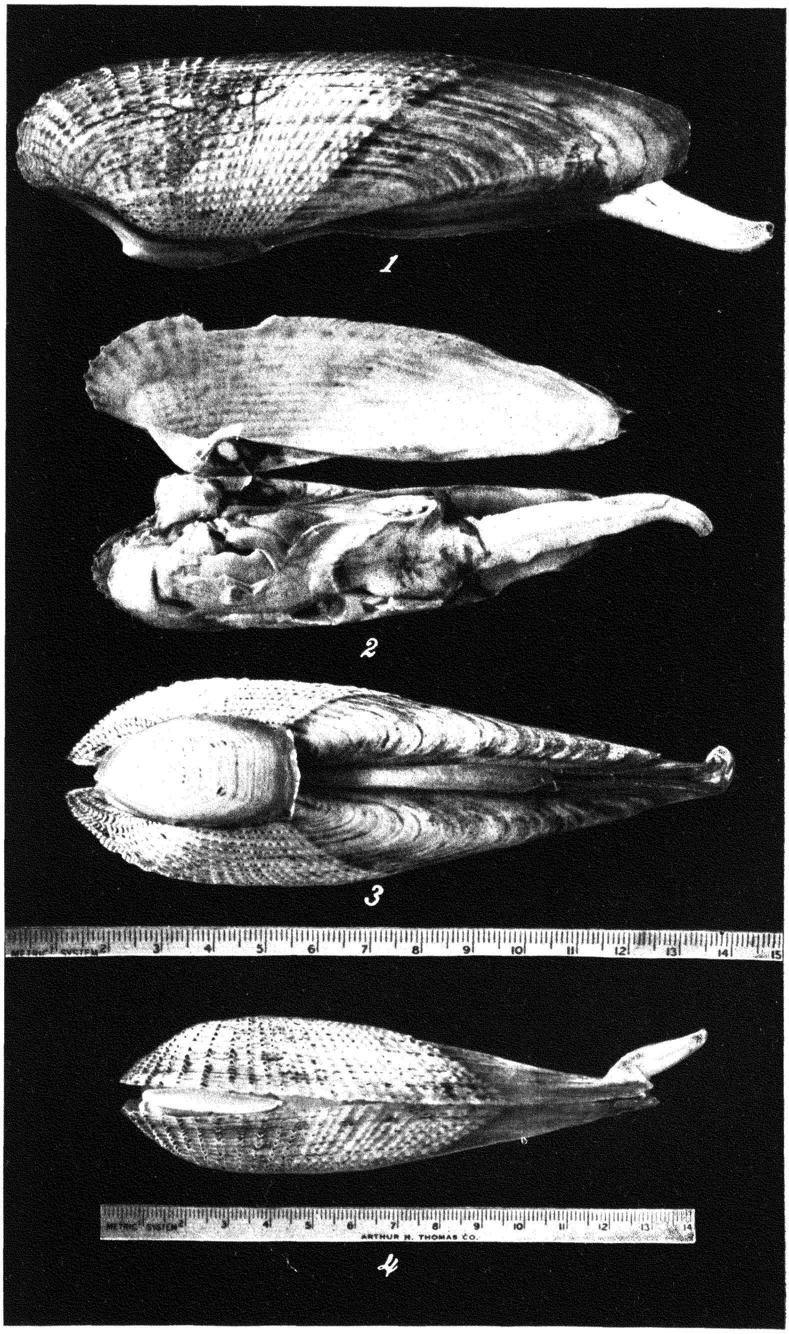
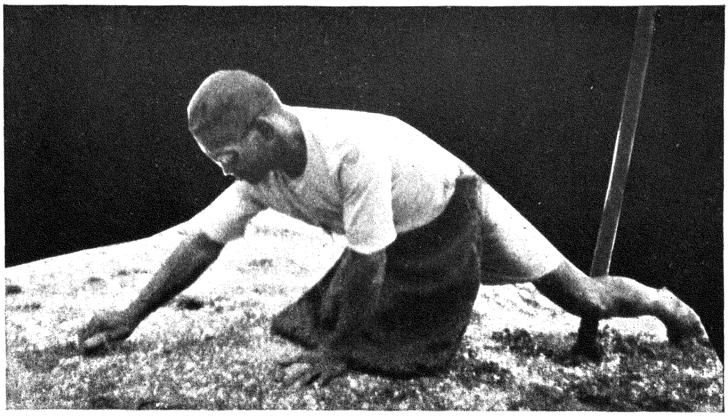


PLATE 1. PHOLAS ORIENTALIS (DIFFERENT VIEWS).



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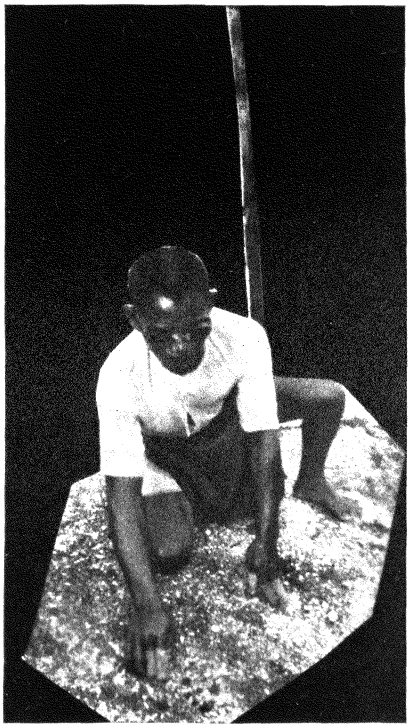

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PLATE 2. DIGGING OF PHOLAS ORIENTALIS.

TWO RARE PHILIPPINE FISHES

By CLARO MARTIN

Of the Fish and Game Administration, Bureau of Science, Manila

ONE PLATE

In June, 1936, when the writer was visiting the Zoölogy Department of Silliman University at Dumaguete, Oriental Negros Province, he was shown two specimens of fish caught off Siquijor Island. One of them is a shark sucker, the other a ground shark. Neither of them have been reported from the Philippines before. Prof. G. Magdamo, in charge of the Department, was prevailed upon to donate the specimens to the Bureau of Science, and they are here reported and described.

ECHENEIS ALBESCENS Temminck and Schlegel.

Echeneis albescens TEMMINCK and SCHLEGEL, Fauna Japon. (1842) 272, pl. 120, fig. 3; GÜNTHER, Cat. Fish. Brit. Mus. 2 (1860) 377; DAY, Fishes of India (1878) 258, 259, pl. 57, fig. 2.

Remora albescens BLEEKER, Ned. Tijds. Dierk. (1863) 236.

Dorsal III, 17; anal III, 19; pectoral I, 18; ventral I, 5; caudal, 18; branchiostegals, 8.

Body depressed anteriorly, subcylindrical posteriorly, slightly compressed at caudal peduncle. Head broadly depressed or flattened above, 3.7 in length as measured from anterior tip or upper lip to edge of opercle, width very slightly less than length; sucking disc broadly elliptical, with 1.7 in length, lamina 13; snout broadly rounded at tip as seen from above, 1.86 in head as measured from anterior tip of upper lip to anterior rim of eye; nostrils two, first tubular, close together; eye lateral, rounded 10 in head, 5.5 in snout; mouth obtuse, lower jaw well protruded in front; angle of mouth in line with vertical from third lamina; teeth villiform in both jaws, an outer enlarged series in lower jaw and vomer. Scales rudimentary. Dorsal inserted on fourth quarter of body, behind anal; base of anal longer than dorsal base; pectorals broad; ventrals small, inserted behind pectoral origin; caudal subtruncate, with a slight median notch.

Alcoholic specimen uniformly light brown.

Described from specimen No. 41351, 289 mm long.

ORECTOLOBUS JAPONICUS Müller and Henle. Plate 1.

Crossorhinus barbatus MÜLLER and HENLE, Sys. Beschr. Plagiostomes (1841) 21, pl. 5; SCHLEGEL, Pisces, Fauna Japon. (1850) 301; DUMERIL, Elasmobranches, Plagiostomes et Holocéphales (1865) 338 (part); GUNTHER, Cat. Fish. Brit. Mus. **8** (1870) 414 (part).

Orectolobus barbatus JORDAN and FOWLER, Proc. U. S. Nat. Mus. **26** (1903) 606.

Orectolobus japonicus REGAN, Ann. & Mag. Nat. Hist. VII **18** (1906) 435; Proc. Zoöl. Soc. Lond. (1908) 356; GARMAN, Mem. Comp. Zoöl. Harv. **36** (1913) 50, 51.

The specimen, a male with long claspers, fits very well the description of Garman, differing from it only in the number of barbels behind the angle of the mouth. Garman's specimen has five barbels, while the present one has four; the first of these is spatulate and notched at the end, the next two are separate; the fourth is bifid near the end.

Specimen No. 41350, here reported, is 878 mm long.

ILLUSTRATION

PLATE 1. *Orectolobus japonicus* Müller and Henle.

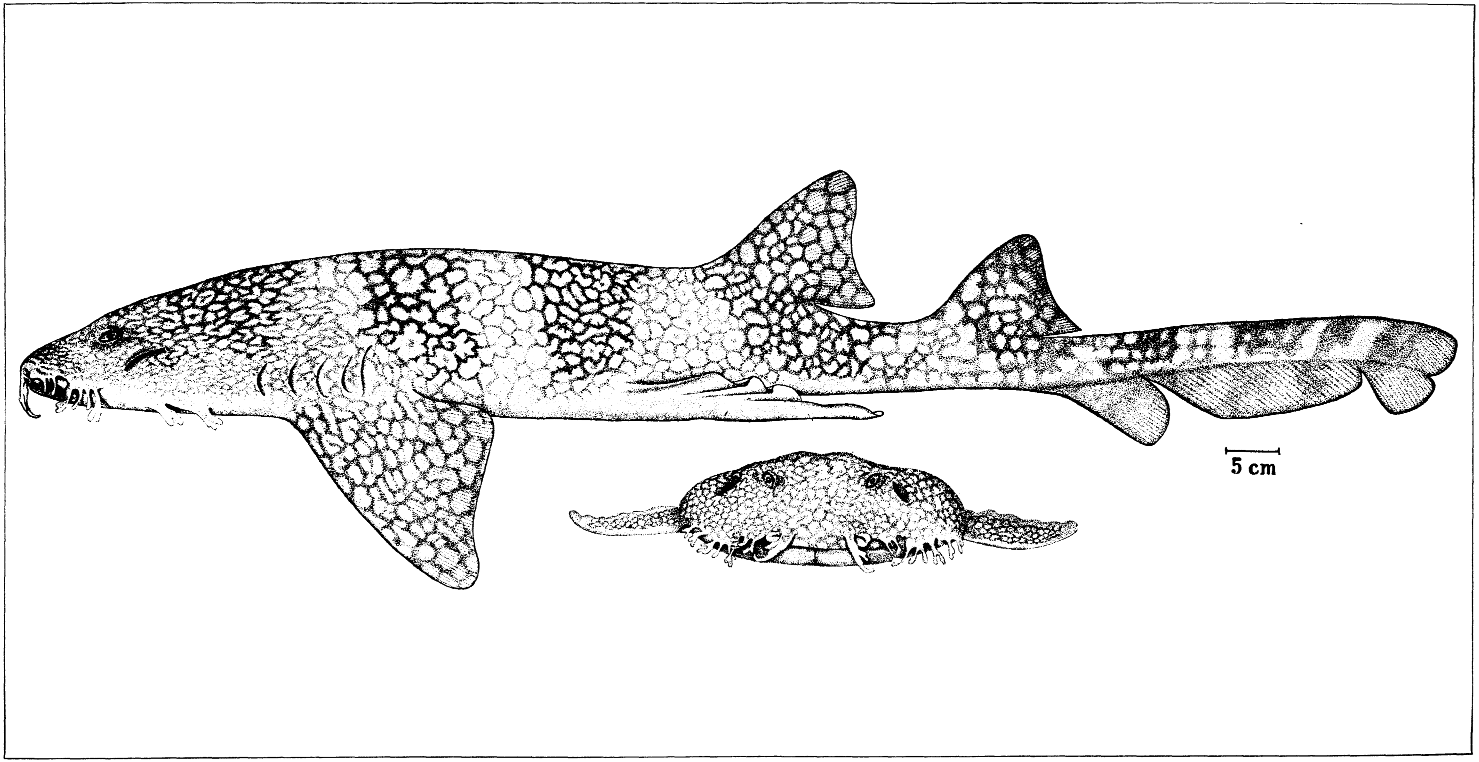

PLATE 1. ORECTOLOBUS JAPONICUS MÜLLER AND HENLE.

BOOKS

Acknowledgment of all books received by the Philippine Journal of Science will be made in this column, from which a selection will be made for review.

RECEIVED

BARBER, M. L. Basic German for science students; with vocabulary and English translations of the German passages. 3d ed. Cambridge, W. Heffer & Sons ltd., 1937. 186 pp. Price, 6s.

BUCKSTEIN, JACOB. Eat and keep fit. New York, Emerson Books, 1938. 128 pp., charts, tables. Price, $1.

Dr. Colwell's daily log for physicians. A brief, simple, accurate financial record for the physician's desk. Champaign, Ill., Colwell Publishing Co., 1938. Pages not numbered. Price, $6.

DURFEE, CHARLES H. To drink or not to drink. New York, Longmans, Green & co., 1937. 212 pp. Price, $2.

FORMAN, CHARLES. Pig breeding and feeding. The breeding and feeding of English swine in an English climate for the English market. London, Faber and Faber, ltd., 1937. 173 pp., illus. Price, 6s.

GALDSTON, IAGO. Maternal deaths—the ways to prevention. New York, The Commonwealth Fund, 1937. 115 pp. Price, $0.75.

GREGORY, EDWIN, and WALTER W. STEVENSON. Chemical analysis of metals and alloys. With a foreword by Thomas Swinden. London, Blackie & son, ltd., 1937. 375 pp. Price, $6.

HOGNESS, T. R., and WARREN C. JOHNSON. Qualitative analysis and chemical equilibrium. New York, Henry Holt & co. c1937. 417 pp., illus., tables. Price, $2.75.

MCKENNY-HUGHES, A. W. The Bed-bug; its habits and life-history and how to deal with it. 4th edition. London, British Museum (Natural History) Economic Series No. 5. 1937. 19 pp., illus. Price, 6d.

OSGOOD, EDWIN E., and CLARICE M. ASHWORTH. Atlas of hematology. With three hundred and twenty-five illustrations and frontispiece in color. San Francisco, J. W. Stacey, inc., c1937. 255 pp., illus.

PLANT, JAMES S. Personality and the cultural pattern. New York, The Commonwealth Fund, 1937. 432 pp. Price, $2.50.

SPRINKLE, LELAND W. Sprinkle's conversion formulas. Philadelphia, P. Blakiston's son & co., inc. c1938. 122 pp.

VERRILL, A. HYATT. Strange birds and their stories. Mysteries of bird life. Migrations. Nesting habits. Birds of beaches and deserts. Winged jewels. Clowns of birddom. Valuable birds. Bird law courts. Bird communists. Flightless birds. Boston, L. C. Page & co. c1938. 203 pp., plates, illus. Price, $2.50.

VERRILL, A. HYATT. Strange insects and their stories. Boston, L. C. Page & co. c1937. 205 pp., illus., plates. Price, $2.50.

VERRILL, A. HYATT. Strange reptiles and their stories. Boston, L. C. Page & co. c1937. 195 pp., illus., plates. Price, $2.50.

REVIEWS

The Control of Goiter; The Thyroid in Health and Disease. By J. Thompson Stevens. New York, A. S. Barnes and Company, 1937. 211 pp., illus. Price, $2.50.

This book is an important medical treatise on the disease generally known as goiter. Goiter is caused by pathological changes in the thyroid. It attacks a great number of people, and yet is unknown to the majority of them. Through this book the reader can obtain the necessary information about this disease.

In the early chapters of this book the author gives a detailed description of the thyroid gland and of the different endocrine glands of the body physiologically closely connected with it. In reading this book the reader gets a better idea of this important gland, its evolution, anatomical structure, and physiological activities. The essential functions of its secretion in relation to the physical development of the body and the building up of character are interestingly discussed.

This book is a clear and comprehensive study of the different types of goiter as they occur in all classes of people. It includes a careful discussion of the pathology, symptomatology, and epidemiology of this disease, and of the different factors causing its appearance in the human body. It also shows the remarkable progress made in the treatment of this disease through the advanced knowledge of this particular branch of medical science. Effective methods of treatment are discussed, such as the application of medicine, surgery, and irrigation. The author also shows the great possibility of conquering this disease, and illustrates by clinical data the results of his investigations. The information contained in this book, therefore, is of immense value, not only to the medical men but also to those who are not well acquainted with goiter.—P. J. A.

Dr. Colwell's Daily Log for Physicians; A Brief, Simple Accurate Financial Record for the Physician's Desk. Champaign, Ill., Colwell Publishing Company.

This volume is the 1938 edition of this useful record book for medical practitioners which is published annually. It consists of blank forms which are very handy for keeping record of the services and the charges for each patient, arranged by dates.

Following the daily record of each month are given forms for inoculations, business summary, income and disbursements, personal accounts, surgical record, narcotics dispensed, appointments, social security tax, and utility record. Forms are also provided for obstetrical waiting list, notifiable diseases, annual summaries, and records of deaths. The use of this record book is highly recommended to medical practitioners who want to keep record of their patients as well as of their business.

—P. S. S.

Occidental Therapeutics in the Netherlands East Indies During Three Centuries of Netherlands Settlement. (1600–1900). By D. Schoute. Batavia, Netherlands Indies Public Health Service, 1937. 214 pp.

Doctor Schoute deserves commendation for ably presenting in book form the many isolated facts of medical interest in the archives of the Netherlands East Indies and from the libraries in Holland. A great deal of the material has been drawn from the ship surgeon's journals. This book has been published on the occasion of the Inter-Governmental Conference of Far Eastern Countries on Rural Hygiene held at Bandoeng in August, 1937.

The reviewer found several interesting facts about medical problems and progress in the Netherlands East Indies which are similar to conditions in our country, such as follows:

1. Occidental therapeutics in the East Indies had its beginnings in the establishment of the United East India Company in 1602, eighty-one years after the discovery of the Philippine Islands by Magellan.

2. During the whole existence of the Company from 1600 to 1800 the medical service was entrusted to surgeons similar to our "cirujanos ministrantes" which abounded in Manila and environs during the Spanish regime and the early part of American sovereignty. The surgeons were medical men without academic attainment. They were replaced later by practitioners probably equivalent to our "practicantes."

3. The prevailing diseases in the Netherlands East Indies were similar to those occurring in our country under Spanish rule and the early part of the American occupation, such as fevers, typhoid, typhus, smallpox, malaria, dysentery, cholera, beriberi, leprosy, measles, influenza, dengue, framboesia, syphilis, pneumonia, pulmonary tuberculosis, diphtheria, tetanus, and rabies.

4. The first hospital in Java was established in 1622 at Batavia some twenty-six years after the foundation in 1596 of

San Juan de Dios Hospital, Intramuros. As it was believed that infected air was lighter than pure air the windows of the hospitals were placed high up in the walls.

5. The Javanese had, however, their School for Native Doctors in 1851, some twenty years before the establishment of the Department of Medicine in the Pontifical University of Santo Tomas, reputed to be the oldest University under the American flag. In 1898 the School for Native Doctors was transformed into the School for the Education of Native Physicians, which in turn was converted into the College of Medicine in 1927.

6. In the interests of health, and believing that Batavia lacked adequate circulation of fresh air, the walls and the gates of the city were demolished. This fact brings to one's mind the consideration whether it is advisable to have the walls and the gates of Intramuros dismantled for the sake of health or conserved for their historical significance.—R. G.

The British Plastics Yearbook, 1938; The Handbook and Guide to the Plastics Industry. London, Plastics Press Ltd. 596 pp.

In plan, style, and make-up this book is similar to its predecessors. It has the same sections as the former editions; namely, Editorial, Names and Addresses, Proprietary Names, Materials, Plant and Equipment, Manufactured Products, Associations, etc., Who's Who in the Plastic Industry, and Data. The editorial section is particularly interesting as it gives a good review of the materials of the plastic industry, plastic substitutes, cellulose acetate, ureaformaldehyde resins, and cast-phenolic resins. The last section (Data) gives tables of various kinds which are very helpful in making rapid calculations. Names, addresses, and general information useful to those interested in this line are given in the other sections. A very good book for people who wish to keep up-to-date in the plastic industry.—A. P. W.

Sterols and Related Compounds; A Series of Three Lectures Delivered at the Institute of Biochemistry, Cambridge. By E. Friedmann. Cambridge, W. Heffer & Sons Ltd., 1937. 100 pp. Price, 75d.

This book consists of a series of three lectures delivered at the Institute of Biochemistry, Cambridge, by Prof. E. Friedmann. The first lecture reviews the important researches on sterols, bile acids, heart poisons, and saponins. The second lecture is devoted to vitamin D, and the third to sex hormones

and carcinogenic substances. Prof. Sir Frederick Gowland Hopkins, who wrote the foreword to this book, states:

> The extraordinary activity in the study of the sterols which recent years have seen, arising both from the inherent chemical interest of these substances and from the recognition of their immense biological importance, has produced a widely scattered literature, requiring much effort for its digestion and appraisement.
>
> Dr. Friedmann has not only brought together all the essential facts contained in that literature, but has presented them in a fashion which should be acceptable alike to organic chemists and to those whose interests are more particularly biological.
>
> He has dealt with the development of the subject on historical lines, and presented the more significant stages of that development in logical sequence. He has thus made it easy to follow the main lines of progress without neglecting the side lines which may display their own importance in the future.
>
> While dealing very thoroughly with constitutional questions and with structural relationships within the sterol group, he supplies a fully adequate account of the physiological, pathological and pharmacological properties of those members of the group which have proved to be active on such lines.

The author concludes his excellent treatise on sterols and related compounds with the following:

> The work done to elucidate these chapters of biochemistry is certainly one of the most brilliant in modern science. It carries on the great traditions of organic chemistry as a descriptive and constructive science creating permanent values. No biochemist can approach this part of biological chemistry without feelings of the highest admiration for the work done in this field and deepest gratitude to the pioneers who succeeded in deciphering these pages of Nature.

—A. P. W.

Thermodynamics; A Practical Text Covering the Fundamentals of Thermodynamics That Are Basic to the Engineering Field. By Stanton E. Winston. Chicago, American Technical Society, 1937. 178 pp., illus. Price, $1.50.

One virtue of this book is its practical, clear, and easy-to-understand treatment and presentation of the general principles of thermodynamics. This fact makes the book a good text for beginning students in engineering. Laws and processes are well explained, followed by formulas and practical problems. All sorts of practical problems are given, involving the laws of gases, thermodynamics behavior for ideal gases, heat-engine cycles, and vapors, the solutions of which are shown in such a way that they can be followed without difficulty. Engineers will also find this book a valuable guide in dealing with the various problems of heat.—M. P. R.

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THE FOOD CONSUMPTION OF ONE HUNDRED FOUR FAMILIES IN PACO DISTRICT, MANILA [1]

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The ill health occasioned by malnutrition is of as much importance to public health as the ill health caused by microbic and parasitic disease. A poor diet may bring in its wake not only the well-known deficiency diseases, but also certain diseases associated with specific organisms, such as tuberculosis and pneumonia. Moreover, there is a growing tendency at present to ascribe much previously mysterious sickness and debility to dietary deficiency.

The School of Hygiene and Public Health of the University of the Philippines maintains an urban health demonstration unit in the district of Paco, Manila, which carries out an extensive health-promotion program. Diet being recognized as one of the major factors influencing public health, it was suggested by Dr. P. I. de Jesus, acting head of the Department of Sanitary Engineering, Industrial Physiology and Chemistry, that an appraisal of the nutritive value of the diet of the residents of this district be undertaken.

Heretofore dietary studies of Manila residents have been confined largely to groups of people whose food is supplied by certain institutions, like Welfareville (Concepcion, 1937; Santos and Pidlaoan, 1937), or Bilibid Prison (Aron, 1909; Strong and Crowell, 1912; Concepcion and Mañalak, 1919; and Santos and

[1] Read at the 14th Scientific Conference held under the auspices of the National Research Council of the Philippines October 15, 1937.

Pidlaoan, 1933), or by dormitories and restaurants (Concepcion and Samson, 1931; Concepcion, 1936). The selection of food in these cases was of necessity subjected to certain restrictions, and cannot be considered representative of the population.

What is considered the best method of determining the diet of a people, however, is to observe how much and what kind of food is consumed by persons who are free to choose their food according to their usual custom. The present report is concerned with the food consumption of 104 families of workingmen, taken from October, 1936, to March, 1937. The families were selected from residents of the district of Paco, Manila. They had complete freedom in the selection of food.

The plan adopted in this study is the so-called inventory system; that is, food records were made for every family. Each food record included the weight, as purchased, and the cost of the food materials consumed in the three principal meals of one family for one day, as well as age, sex, weight, literacy, occupation, and income of the members of the household, the value of the house, if owned, and other pertinent data. Messrs. Eugenio Narcise and Benigno Reyes, field workers, assisted in the collection of these data.

DATA

The families averaged six members each, the smallest being two and the largest, twelve. The average daily income for one family was found to be 1.83 pesos.[2] A good majority (67 per cent) owned their houses, while the rest (23 per cent) rented theirs. Of those who owned their houses, however, only a few (4 per cent) actually owned the land on which their houses were built. The proportion of illiteracy was very small, being only 6 per cent (38 out of 666). Adult males above 14 years of age averaged 53 kilograms in weight. The commonest foods eaten, besides rice and bread, were bañgos (*Chanos chanos*), shrimps, and dalagang bukid (*Cæsio cuning* Bloch) among seafoods; and among the fruits and vegetables, bananas, tamarind, tomatoes, and onions. Coffee was a very common beverage, and Purico, a vegetable fat manufactured from coconut oil, was extensively used in cooking.

NUTRITIVE VALUE OF THE AVERAGE DIET

In analyzing the nutritive value of the diets of the 104 families, five factors were considered; namely, total energy, proteins, fats, carbohydrates, and ash or minerals. These factors

[2] One peso equals 50 cents United States currency.

were evaluated for each food by the item-by-item method, which, although a tedious procedure, is preferable to the short-cut method devised by Hawley (1929). The tables prepared by Santos and Adriano (1929), Santos (1931), Hermano (1932), and Adriano (1932) were utilized in the computation. Food materials the analyses of which do not appear in these tables were analyzed, and form the subject of a separate paper (Gutierrez). In order to facilitate comparison, the results expressed in calories and in grams of proteins, fats, carbohydrates, and minerals for each family, were reduced to adult male units according to Lusk's coefficients (Lusk, 1928). Breast-fed babies were excluded.

LUSK'S COEFFICIENTS

Age in years.	Cœfficient.
0 to 6, both sexes	0.50
6 to 10, both sexes	0.70
10 to 14, both sexes	0.83
14 +, females	0.83
14 +, males	1.00

The average caloric intake was found to be 2,107 calories (±40.87) (Table 3). The bulk of the calories was furnished by fats and carbohydrates which respectively yielded 15 per cent and 73 per cent of the total calories. Proteins furnished 12 per cent of the total calories (Table 4), a figure well within the standard set up by Sherman (1932), who advocates that proteins should furnish 10 to 15 per cent of the total calories.

The protein intake averaged 63 (±1.35) grams per adult male unit per day. Calculation of the average protein intake per kilo of body weight gave 1.19 grams.

It is not sufficient, however, to know the quantity of proteins ingested; it is equally important to know the quality of the proteins, for it is well known that plant proteins are biologically inferior to animal proteins. For this purpose the percentage distribution of proteins was calculated with the following results:

Protein.	Per cent.
Plant (Rice alone supplied 38 per cent of the total proteins)	55
Animal	45

The figure for rice proteins is low (see Table 7 for comparison), but this may be explained by the fact that 64 per cent of the households had bread for breakfast. Further analysis to determine from what group of food materials the bulk of animal proteins came, gave the results shown in Table 1.

TABLE 1.—*Percentage distribution of proteins.*

Food.	Animal proteins.	Total proteins.
	Per cent.	*Per cent.*
Milk and dairy products	2	1
Meat	16	7
Fish	80	36
Eggs	2	1
Total	100	45

Thus the major portion of the animal proteins in the diets studied was furnished by fish, a small portion by meat, and only a negligible part from eggs, milk, and dairy products. The distribution is about even between animal and plant sources, which is as it should be (Sherman, 1932), and lately the Committee of the British Medical Association (1933) recommended that at least 50 per cent of the total proteins should come from animal sources.

It has been observed by various investigators that Filipinos subsist mainly on a diet of rice and fish (Roxas, 1922; Santos, 1930; and Concepcion, 1933). Aron (1909) stated that "the Filipino lives principally on rice and fish, some vegetables and fruits, and very seldom eats meat for the reason that it is not always obtainable." This was not found to be the case in the present study, for the urban families had equal access to both meat and fish which were sold in about equal abundance in Paco market. The choice could not have been influenced by price, for bañgos, the most common fish in the diets studied, costs on an average from 40 to 50 centavos per kilo, while pork, the most common meat eaten, costs only from 20 to 30 centavos per kilo. These figures were calculated from the current retail market prices. Upon inquiry as to the reason for this preference many of the families claimed that they preferred fish because they can eat more rice when fish instead of meat is served with the meal. Meat they claimed was all right once in a while—on Sundays, holidays, and on festive occasions—but for their daily meals they much preferred fish.

The authors were constrained to assess the average mineral intake merely from an average of the total ash in the diets studied, without attempting to analyze further the principal minerals needed by the body; namely, calcium, phosphorus, and

iron, on account of the paucity of data on the analysis of Philippine foods for these elements. Thus, while the authors are fully conscious of the importance of evaluating these specific minerals, in the absence of complete data the average total mineral intake alone was calculated, giving a value of 11 ± 0.40 grams per adult male unit.

The evaluation of the vitamin contents of the diets is not as easy as that of the other nutrients, since the data on the vitamin content of Philippine food materials is purely qualitative. Consideration of the vitamin factor has perforce been limited to a rough estimation of the probable adequacy of the vitamin intake based on the presence of vitamin-rich foods in the diets. Only one vitamin was considered in detail; namely, vitamin B_1, since this vitamin seems to be the one in which the Filipino diet is generally deficient. The authors found 6 manifest cases of beriberi, occurring exclusively in mothers, out of 666 individuals included in this survey. The occurrence of cases exclusively in mothers is very striking. They venture to infer that the intake of vitamin B_1 is just sufficient for the average adult, but becomes insufficient when an additional drain, such as occurs in pregnancy and lactation, is made on the individual. Cowgill and DuBois bear out this statement. DuBois (1924) says, "studies of the metabolism during pregnancy indicate that there is indeed increase in the basal rate and this is accounted for by the metabolism of the growing fetus." Cowgill (1934), referring to the relation of the metabolic rate to the vitamin requirement, states, "this increase in the vitamin B requirement associated with the rise in the metabolic rate may explain some of the observations reported in the literature."

Recently Cowgill (1934) advanced a formula for determining the vitamin B_1 requirement of man. The formula is

$$\frac{VIT_1}{CAL_1} = 0.0000284 \text{ body weight grams}$$

where VIT_1 represents the number of milligrams of a given vitamin B_1 concentrate (lot 985 of Yeast Vitamin Powder, Harris) required daily by a given individual; and CAL_1, his daily total energy exchange. If we apply this formula, and calculate the vitamin B_1 content of the foods eaten by the families included in this study with the aid of the tables furnished by Cowgill for the vitamin B_1 index values of foods, the results shown in Table 2 will be obtained.

TABLE 2.—*Comparison of vitamin calorie ratios obtained for all families and for families with beriberi.*

Families.	Number.	Mean VIT/CAL ratio.	Body weight for which this value of VIT/CAL ratio is just adequate.	Average body weight of adult males.
			Kilos.	*Kilos.*
All	104	1.21	42	53
With beriberi	6	0.95	34	53

Table 2 shows an average value of 1.21 for the VIT/CAL ratio of the 104 families. This value, according to the prediction chart of Cowgill (1934), just suffices for a man weighing 42 kilograms, whereas the average weight of the men in the families studied is 53 kilograms. It is obvious that most of the diets, as judged by the formula, were deficient in vitamin B_1 and should have permitted beriberi to develop, which in fact they did, for beriberi occurred in 6 families out of the 104 studied (6 out of the 666 individuals, or 9 per 1,000). When the families in which beriberi occurred were considered alone, an average VIT/CAL ratio of 0.95 was obtained, adequate for a body weight of only 34 kilograms. The results given here should not, however, be construed to mean that the authors have accepted the validity of Cowgill's formula. Rather, they should be taken as a test of its validity. Further tests of the formula are advocated.

To determine the degree of variability of the five nutrients studied, their coefficients of variation were computed (Table 3). The figures obtained reveal that the energy value and the carbohydrate content of the diet with coefficients of 29 per cent and 28 per cent, respectively, are the least variable components, while fat consumed in amounts within 66 per cent of the mean constitutes the most variable factor. The latter is largely influenced by the use of Purico in the cooking of food. It is easy to change the fat content of the diet by increasing or decreasing the consumption of this article. Proteins and ash with coefficients of 32 per cent and 54 per cent, respectively, occupy intermediate positions.

TABLE 3.—*Nutritive value and cost per adult male of average diet.*

Evaluation.	Proteins.	Fats.	Carbo-hydrates.	Ash.	Calories.	VIT/CAL.	Cost.
	g.	*g.*	*g.*	*g.*			*Peso.*
Average	63	33	377	11	2107	1.21	₱0.17
P. E. mean	±1.35	±	±7.01	±0.40	±40.87	±0.04	±0.004
Standard deviation	20	22	104	6	606	0.54	0.06
Coefficient of variation, per cent.	32	66	28	54	29	45	35

COMPARISON OF THE PRESENT RESULTS WITH RESULTS OF OTHER STUDIES

The nutritive value of the average diet of the adult male is compared in Tables 4 and 5 with results gathered from other investigations of family diets. Since the latter were made on rural families, while the present study is concerned with urban families, the results of the present study were compared with an average of the figures obtained for the rural families. According to the figures presented in Table 5 the average diet of the urban families of Paco, Manila, furnishes slightly less energy with less carbohydrates, more fats, and less minerals, but the same amount of proteins as the average rural family diet. When subjected to statistical test, however, only the difference in fat intake was found to be statistically significant.

TABLE 4.—*Comparative food intake per kilo body weight and calories from proteins.*

Locality.	PC/TC.	P/KBW.	C/KBW.
	Per cent.	*g.*	*Calories.*
Los Baños, Laguna [a]	12.9	1.40	45
Nueva Ecija and Cavite [b]	11.6	1.28	45
Tangos, Rizal [c]	13.4		
Santa Catalina, Ilocos Sur [d]	11.2	1.25	46
Paoay, Ilocos Norte [d]	12.0	1.40	48
Pototan, Iloilo [d]	12.0	1.08	37
Calabanga, Camarines Sur	9.9	1.35	56
Average	11.7	1.29	46
Paco, Manila	12.2	1.19	40

[a] Roxas and Collado (1922).
[b] Santos (1930).
[c] Aycardo (1935).
[d] Santos, Villanueva, and Silva (1936).

TABLE 5.—*Comparative food intake per adult male in Philippine rural districts and in Paco District, Manila.*

Locality.	Proteins.	Fats.	Carbo-hydrates.	Ash.	Calories.
	g.	*g.*	*g.*	*g.*	
Farmers, Los Baños, Laguna [a]	70	----------	----------	----------	2097
Peasants, Cavite and Nueva Ecija [b]	64	16	452	----------	2260
Families in Tangos, Rizal [c]	53	18	309	----------	1613
Santa Catalina, Ilocos Sur [d]	60	15	450	24	2193
Paoay, Ilocos Norte [d]	70	25	448	29	2387
Pototan, Iloilo [d]	54	13	370	8	1831
Calabanga, Camarines Sur	70	33	564	16	2895
Average	63±1.76	20±1.90	432±21.72	19±2.66	2182±97.06
Paco, Manila	63±1.35	33±1.48	377±7.01	11±0.40	2107±40.87

[a] Roxas and Collado (1922).
[b] Santos (1930.)
[c] Aycardo (1935).
[d] Santos, Villanueva, and Silva (1936).

The question naturally arises as to what foods are responsible for these variations in nutrients. For this purpose a study was made of the percentage distribution of calories among the various food groups. According to the data presented in Table 6 the rural family consumed on the average relatively more cereal grains (chiefly rice)—a food group rich in carbohydrates—but less meat, fish, eggs, milk, dairy products, sweets, and fatty foods than the urban family of Paco. This difference is probably due to the fact that while farm families have access to rice often without the necessity of direct expenditure of money, the same is not true of the urban families.

TABLE 6.—*Percentage distribution of calories.*

Locality.	Cereals.	Meat, fish, eggs.	Milk, dairy products.	Fruits, vegetables.	Sweets, fatty foods.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Peasants, Cavite and Nueva Ecija [a]	82.00	10.00	----------	5.00	3.00
Pototan, Iloilo	90.41	5.94	----------	2.59	1.06
Santa Catalina, Ilocos Sur	89.25	5.31	----------	4.19	1.35
Paoay, Ilocos Norte	78.15	10.90	0.25	8.78	1.92
Calabanga, Camarines Sur	79.40	4.33	0.05	13.31	2.92
Average	83.84	7.30	0.06	6.77	2.05
Paco, Manila	70.90	11.30	0.90	7.00	9.90

[a] Santos, 1930.

It is surprising to note that the consumption of fruits and vegetables, foods which can easily be raised on the farms, does not figure prominently in the average rural diets. In fact, the urban families of Paco, who are not so advantageously located,

used these foods more freely than the rural families, with the exception of two groups of farm families, those of Paoay, Ilocos Norte Province, and those of Calabanga, Camarines Sur Province.

As regards the protein intake, while the protein content of these two diets is the same, analysis of the quality of the protein ingested at once shows a disparity (Table 7), for while 45 per cent, or almost one half of the proteins consumed by the urban families of Paco, comes from animal sources, only 33.5 per cent comes from this source in the average rural dietary. The bulk of the protein in the latter comes from rice, which alone yields 56.6 per cent of the total protein intake. One is tempted to infer that the rural families ate more rice, which could be readily obtained often at no cost, in response to the need for more protein.

TABLE 7.—*Comparative distribution of proteins.*

Locality.	Proteins.		
	Plant.	Animal.	Rice.
	Per cent.	*Per cent.*	*Per cent.*
Loa Baños, Laguna [a]	61.0	39.0	55.9
Santa Catalina, Ilocos Sur	69.6	30.4	58.1
Paoay, Ilocos Norte	66.6	33.4	46.7
Pototan, Iloilo	65.1	34.9	59.1
Calabanga, Camarines Sur	70.0	30.0	63.0
Average	66.5	33.5	56.6
Paco, Manila	55.0	45.0	38.0

[a] Roxas and Callado (1922).

The diet of the urban families of Paco is most probably richer in vitamins on account of the greater proportion of the so-called protective foods—fruits, vegetables, meat, milk, and eggs.

On the whole, therefore, the urban families in Paco, Manila, consume diets superior to those of the rural families.

CONSUMPTION OF SUGAR

On account of a movement to increase the per capita consumption of sugar in the Philippines, it was thought timely to include some facts about the consumption of this article of food, which might be of help in ascertaining the possibilities of increasing our sugar consumption. The reported statistics of sugar consumption are not a true measure of actual consumption, since they represent not really consumption, but distribution. A study of the consumption of sugar as it actually enters the

diet of the people furnishes a figure that approaches more closely the actual situation. One such study has been reported by Atienza (1933).

The data presented in Table 8 were gathered not only from families included in the present work, but also from families residing in different regions of the Philippines whose diets were studied by the junior author of this paper (F. O. S.). Under the term sugar various sweetmeats, like *bucayo* [3] and *tiratira,*[4] were included. It appears from Table 8 that the urban families of Paco, Manila, with an average per capita daily consumption of 18 grams, consumed more sugar than any of the rural families, with the exception of those residing in Calauan, Laguna (Atienza, 1933) who consumed on an average 45 grams per capita daily. The percentage of families consuming sugar was also lower for the rural families, again with the exception of the families of Calauan. When all the families are taken together an average per capita daily consumption of 13 grams is obtained. It is noteworthy that the Moros of Ramain, Lanao Province, are very sparing users of sugar—only one family out of 159 studied included sugar in the diet.

TABLE 8.—*Daily per capita consumption of sugar.*

Locality.	Families studied.			Per capita daily consumption of sugar.
	Total.	Consuming sugar.		
			Per cent.	*g.*
Santa Catalina, Ilocos Sur	47	6	13	3
Paoay, Ilocos Norte	59	19	32	3
Calabanga, Camarines Sur	165	62	38	12
Ramain, Lanao	159	1		
Macrohon, Leyte	121	63	52	11
Calauan, Laguna	50	50	100	54
Paco, Manila	104	96	92	18
Average				13

COST OF DIETARY

In a dietary study it is not sufficient to determine the nutritive value of the diet, it is also useful to know how much money is spent for food and exactly how it is spent, for the problem of food consumption is unquestionably economical as well as nutritional. To quote Hawley (1932):

[3] A sweetmeat made from shredded coconut and brown sugar.

[4] A candy stick manufactured from brown sugar.

Although welfare is the primary purpose of consumption, yet price is the factor which determines to a large extent what we consume. We may know that for our best welfare certain commodities are essential, but if their price is prohibitive we seek to find substitutes or, failing, do without them altogether.

In the families studied the writers found that an average of 17 centavos (±0.004) per adult male was spent daily for food. Only a negligible quantity of foods, furnished either by home gardens, home poultries, or by neighbors and visitors, necessitated no actual expenditure of money.

The daily food cost per adult male was further analyzed to determine any possible influence of the number of members in the household to this value. Accordingly, the families were grouped into those having two, three, four, or more, members, and the corresponding average daily food cost per adult male calculated. The results are given in Table 9.

TABLE 9.—*Relation between daily food cost per adult male and the number of members in a household.*

	Number of members in a household.				
	2	3	4	5	6
Number of families	7	12	12	13	13
Average daily cost per adult male ... peso.	0.20	0.19	0.18	0.17	0.16
Average daily income ... pesos.	0.67	1.14	1.01	2.20	1.54

	Number of members in a household.					
	7	8	9	10	11	12
Number of families	6	17	8	7	6	3
Average daily cost per adult male...peso.	0.13	0.13	0.18	0.22	0.18	0.15
Average daily income ... pesos.	1.22	1.68	2.31	4.61	2.17	2.80

Table 9 shows that the average daily food cost per adult male unit in families of 2 members was 20 centavos. This amount became 19, 18, 17, 16, and 13 in families having three, four, five, six, seven, and eight members, respectively. With the exception of families having nine, ten, eleven, and twelve members it seems that the tendency is for the per capita food expenditures to decrease with an increase in the number of members in the household. This relation may have arisen from the fact that certain economies were effected in buying and preparing food for larger families, or that in larger families there was an increasing need of curtailing food expenditures in order to buy other necessities.

The apparent discrepancy in families having nine or more members can probably be explained by their bigger incomes, so that the need for cutting down on food expenditures in these families is not so great.

To determine how the money spent for food was apportioned among the different food materials, the foods were divided into five groups and the percentages of food costs from these groups at various cost levels calculated. The results appear in Table 10. The proportion spent for cereals (chiefly rice) varied from 52.6 per cent at the lowest level (below 10 centavos) to 24 per cent at the highest level (30 centavos or more), and showed a regular decrease as cost increased. The tendency to spend a constantly decreasing proportion of the food money for cereals as total food expenditures increase is well recognized in the distribution of food money. In the case of meat, fish, and eggs, however, the reverse is true; that is, this group of foods increased in relative value as food costs mounted. No money was spent for milk and dairy products at the lowest level of food cost, and only a small but fairly uniform amount was spent for this group at the higher levels. The percentage for fruits and vegetables showed some irregular tendency to increase as costs increased, varying from 8 per cent at the lowest level to 24 per cent at the highest level. The percentage for sweet and fatty foods and food accessories was fairly even throughout the various cost levels, and averaged 9.9 per cent. When all the families are considered, the bulk of the food money (40.7 per cent) was spent for meat, fish, and eggs, about a third (32.5 per cent) for cereals (rice and bread), while the remainder was distributed between fruits and vegetables (14.3 per cent), sweet and fatty foods and food accessories (9.9 per cent), and milk and dairy products (2.6 per cent).

Comparison of the average percentage distribution of food cost in the diets studied with the standard advocated by Sherman (1932) for a low-cost diet (Table 10) shows that the distribution nowhere approaches the Sherman standard except in the case of two food groups; namely, fruits and vegetables, and sweet and fatty foods and accessories. The proportion of the money spent for cereals and meat, fish, and eggs is well above the standard recommended by Sherman, while that for milk and dairy products is only about one-fifteenth of the amount that Sherman advises should be spent for this group of foods. It is realized, however, that because of differences in price level and

TABLE 10.—*Proportion of food money spent for various food groups at different levels of food cost.*

Total food costs per adult male.	Percentage of food costs for— Cereals.	Meat, fish, and eggs.	Milk and dairy products.	Fruits and vegetables.	Sweet and fatty foods and accessories.	Number of families.
Centavos.						
10 or less	52.6	28.6		8.0	10.8	11
10–14	34.7	38.2	2.0	13.1	11.6	31
15–19	31.2	39.1	2.8	16.6	10.3	28
20–24	24.8	48.8	3.8	15.8	6.8	25
25–29	26.7	47.3	3.1	12.1	10.8	7
30 or more	24.0	39.5	3.0	24.0	9.5	2
All families	32.5	40.7	2.6	14.3	9.9	104
Sherman Standard, 1932	12–15	10–15	27–33	15–18	10–15	

availability of these different food groups between this country and the United States the Sherman standard is not strictly applicable. For instance, it would be folly to advocate that the money allotted to milk and dairy products be increased to approach that recommended by Sherman, since in the Philippines these food products are expensive and not always readily available.

The weight given to food expenses in the total budget is of interest as an index of standard of living (Hawley, 1932). The balance remaining after deducting the food expenses represents the amount available for other wants, like clothing, housing, and the "higher things" of life. It follows that an increase in the proportion of the budget spent for food is only possible at the expense of these other wants, and would, therefore, indicate a lower standard of living.

For this purpose the data collected were analyzed to establish the weight given to food expenses in the total budget at various levels of daily family income. Since it would be of interest to know how much in the way of welfare was rendered by the diets at the different levels of income, their nutritive value was also calculated. The results are shown in Table 12.

Table 12 shows that the proportion of the income spent for food is clearly related to differences of family income. Starting from the lowest level of family income (below 1 peso) the proportion of the income spent for food decreased from 103 per cent, and at the highest level (5 pesos and over) became only 18 per cent. This tendency to spend a smaller proportion for food

TABLE 11.—*Comparative food intake and cost per adult male unit.*

Family.	Protein.	Fats.	Carbohydrates.	Ash.	Calories.	VIT/CAL. [b]	Cost.
	g.	*g.*	*g.*	*g.*			*Peso.*
1	58	38	455	8	2422	0.59	0.16
2	74	19	486	18	2470	1.22	0.12
3	96	12	536	13	2583	0.59	0.16
4 [a]	70	50	365	12	2251	1.10	0.13
5	50	13	236	14	1296	0.61	0.10
6	86	23	516	14	2677	0.98	0.20
7	110	64	388	13	2638	1.95	0.23
8	47	35	261	6	1589	0.80	0.13
9	63	23	381	9	2558	1.15	0.17
10	71	41	512	10	2709	0.68	0.15
11	60	6	250	17	1331	2.36	0.12
12	----	----	----	----	----	----	----
13	124	26	778	15	4089	2.09	0.28
14	86	73	375	12	2534	1.68	0.12
15	51	29	243	9	1478	1.50	0.13
16 [a], 17 [a]	54	8	374	18	1833	0.82	0.10
18	43	8	245	6	1252	0.96	0.11
19	64	53	594	8	2644	1.30	0.14
20	75	66	384	10	2472	0.71	0.18
21	133	97	645	23	4089	1.38	0.29
22	89	92	413	10	2919	0.99	0.28
23	79	46	438	14	2549	0.82	0.18
24	70	28	295	7	2009	1.50	0.20
25	71	15	242	18	1423	2.15	0.15
26	75	26	309	10	1819	2.59	0.11
27	48	32	200	5	1278	1.63	0.12
28	35	5	309	8	1451	0.78	0.07
29	37	4	332	11	1544	0.55	0.07
30	69	55	382	9	2243	1.01	0.18
31	60	31	220	7	1429	1.43	0.22
32	56	40	297	7	1783	1.28	0.14
33	70	28	483	10	2523	1.01	0.20
34	51	17	317	11	1639	1.05	0.08
35	58	34	396	12	2175	2.19	0.19
36	43	34	253	8	1526	0.77	0.11
37	54	34	377	8	2026	1.00	0.13
38	51	17	271	9	1482	1.34	0.17
39	69	35	363	13	2098	0.92	0.24
40	72	25	406	14	2192	1.20	0.23
41	53	39	278	9	1666	1.16	0.12
42	84	24	496	11	2602	0.80	0.24
43	86	12	322	22	1717	1.92	0.21
44	67	9	212	9	1227	1.39	0.07
45	85	73	558	13	3312	1.86	0.32
46	60	54	427	8	2124	1.13	0.19
47	40	8	347	7	1662	0.59	0.09
48 [a]	70	34	490	13	2611	0.66	0.18
49	82	65	454	12	2760	1.49	0.23
50, 51	61	11	374	8	1888	0.84	0.15
52	35	4	207	4	1030	0.85	0.05
53	69	81	464	11	2889	1.22	0.26
54	67	30	356	8	2011	0.92	0.17
55	67	46	467	9	2592	0.74	0.14
56	55	27	350	8	1909	1.21	0.16

[a] Families with beriberi cases.

[b] VIT/CAL ratio for 58 kg body weight=1.50.

TABLE 11.—*Comparative food intake, etc.*—Continued.

Family.	Protein.	Fats.	Carbohydrates.	Ash-	Calories.	VIT/CAL.[b]	Cost.
	g.	*g.*	*g.*	*g.*			*Peso.*
57	91	45	506	19	2860	1.38	0.22
58	50	29	286	23	1646	1.98	0.15
59	42	30	221	7	1349	1.26	0.12
60	111	122	436	14	3339	2.28	0.23
61	36	17	191	4	1090	0.85	0.07
62	73	24	545	9	2245	0.82	0.17
63	53	48	287	8	1838	1.42	0.19
64	52	8	392	6	1840	0.95	0.18
65	68	16	500	19	2424	1.04	0.18
66 [a]	70	29	448	11	2394	1.53	0.29
67	67	29	535	9	2638	0.80	0.21
68	84	50	508	17	2913	0.89	0.29
69	71	8	450	17	2206	1.04	0.21
70	110	67	494	20	3151	1.52	0.23
71	110	48	560	31	3192	3.09	0.24
72	65	20	291	14	1649	4.00	0.24
73	67	34	378	17	2148	1.11	0.20
74	56	11	312	7	1610	1.10	0.22
75	40	10	256	5	1306	0.82	0.09
76	92	40	364	10	2237	0.99	0.14
77	53	7	342	7	1684	0.92	0.13
78 [a]	55	27	373	7	2005	0.83	0.14
79	48	96	254	7	2123	1.47	0.20
80 81	78	96	567	15	3536	1.80	0.38
82	32	7	323	5	1516	0.67	0.09
83	70	19	466	37	2275	1.40	0.22
84	50	62	290	9	1972	1.08	0.26
85	50	24	308	9	1689	0.91	0.14
86	71	29	451	11	2404	1.23	0.13
87	41	12	338	7	1664	0.81	0.09
88	51	54	395	10	2333	1.40	0.15
89	72	39	472	10	2570	0.92	0.23
90	43	15	372	5	2217	0.51	0.13
91	58	40	379	12	2159	1.62	0.24
92	74	41	428	12	2436	1.74	0.18
93	45	23	364	8	1894	0.98	0.12
94	-------	-------	-------	-------	-------	-------	-------
95	-------	-------	-------	-------	-------	-------	-------
96	41	27	341	8	1800	0.92	0.12
97	33	14	311	5	1543	0.65	0.11
98	62	19	251	30	1636	1.33	0.17
99	34	12	345	5	1667	0.54	0.08
100	48	18	368	6	1854	0.90	0.13
101	38	24	300	5	1611	1.13	0.14
102	59	37	388	12	2180	1.10	0.18
103	41	22	291	6	1568	0.81	0.13
104	47	29	344	12	1872	1.05	0.15
105	53	31	267	30	1605	1.68	0.18
106	48	48	373	8	2168	1.03	0.19
107	33	30	243	5	1413	1.33	0.12
108 [a]	57	28	465	10	2396	0.73	0.19
109	89	35	453	12	2517	1.50	0.24
110	52	34	301	8	1766	0.76	0.13
Average	63	33	377	11	2107	1.21	0.17

[a] Families with beriberi cases.

[b] VIT/CAL ratio for 53 kg body weight=1.50.

TABLE 12.—*Proportion of the family income spent for food and the corresponding nutritive value of diets at different levels of income.*

Levels of family income per day.	Number of families.	Proportion of income spent for food.	Corresponding nutritive value of diet.					
			Proteins.	Fats.	Carbohydrates.	Ash.	Calories.	VIT/CAL.
Pesos.		*Per cent.*	*g.*	*g.*	*g.*	*g.*		
1.00 and less	19	103	61	24	371	12	1996	1.10
1.00–1.99	49	50	62	33	376	11	2094	1.11
2.00–2.99	15	48	64	29	381	12	2059	1.17
3.00–3.99	9	32	74	48	398	11	2404	1.44
4.00–4.99	3	36	66	58	363	9	2165	1.74
5.00 and over	4	18	61	50	374	12	2249	2.18
All families	[a] 99	48	65	40	377	11	2161	1.46

[a] Five families were omitted because the heads of the families were jobless at the time this survey was made.

as the income of the family increases is a phenomenon first pointed out by Engel in 1857. It has come to be regarded as one of the fundamental laws of consumption and is useful in judging and comparing standards of living (Hawley, 1932). If we set the poverty line arbitrarily at 50 per cent—Hawley (1932) says that "when more than 50 per cent of the income goes for food not much is left for clothing, housing and the 'higher things' of life"—most families (about 80 per cent) are at, or close to this line, while 19 families out of 99, or about 20 per cent, are below this line. It is interesting to note that this arbitrary poverty line coincides with a family income level of 1 peso to 1.99 pesos.

With regard to the nutritive value of the diets corresponding to the various levels of family income, one will observe that there is not much difference between them with regard to protein, carbohydrate, and caloric content. However, with respect to fat and vitamin B_1 contents (as judged by Cowgill's formula) the superiority of the diets consumed by the families earning higher daily incomes is at once manifest. The inferiority of the diets of the poorer families in fats finds its explanation in the fact that fats, especially animal fats, are expensive. They are, however, invaluable in the diet as vitamin carriers, especially of the fat-soluble vitamins. Cowgill (1934) has also shown that pork is a rich source of vitamin B_1. A corresponding increase in vitamin B_1 content of the diets (as judged by Cowgill's for-

mula) is manifested as the level of family income increased. This seems to support Aykroid's (1936) statement that "beriberi is a poverty disease."

DAILY FOOD INTAKE OF TWO FAMILIES FOR ONE MONTH

To determine the daily fluctuation of the food intake and cost, the dietary of two families was studied for a period of one month, including Sundays and holidays. These families were selected from the 104 families included in the survey. The basis of the selection was largely their willingness to coöperate. The first family (family A) received a steady income; the head of the household, a chauffeur, received a monthly income of 40 pesos. The second family (family B), however, had an irregular income; the head of the household, a carromata driver, earned 60 to 80 centavos daily, even less at times. The results of this study are presented in Table 13. With the exception of the mineral intake, which was the same in both families, family A who spent more for food seemed to have consumed a superior diet. When the differences observed in the protein, fat, carbohydrate, and caloric intake of the two families were subjected to statistical test the differences observed between the protein and fat intake were found to be statistically significant, while the differences in carbohydrate and caloric intake were not found to be statistically significant. Of the nutrients, therefore, protein and fats are probably the factors most likely to be affected by the food cost. Thus here is further evidence of the intimate relationship existing between income, food cost, and nutritive value of food intake. To determine the degree of variability of the nutrients their coefficients of variation were calculated (Table 13). Fat intake with coefficients of variation of 45 per cent in family A and 77 per cent in family B was the most variable factor in the two diets, a finding which conforms to our previous observation (Table 3). In fact, with the exception of the protein intake, which constitutes the least variable factor in the diet of family B, the degree of variability of the nutrients in the diets of families A and B agrees with that found for the 104 families whose diets were studied for only one day. It would seem, therefore, that the authors were justified in taking the results of the study of a day's diet of a family as more or less representative of its daily diet.

TABLE 13.—*Daily food intake of two families.*

	Family.	Proteins.	Fats.	Carbohydrates.	Minerals.	Calories.	Cost.
		g.	*g.*	*g.*	*g.*		*Peso.*
Average	A	57±1.27	39±2	378±5	9±0.22	2138±35	0.20±0.005
Coefficient of variation, per cent	A	18	45	11	20	13	20
Average	B	49±0.45	13±1	353±7	9±0.32	1739±33	0.11±0.003
Coefficient of variation, per cent	B	7	77	15	29	15	24

SUMMARY

1. A study of the food consumption of 104 families residing in Paco, Manila, showed an average daily intake per man unit of 2,107 (±40.87) calories, 63 (±1.35) grams of proteins, 33 (±1.48) grams of fats, 377 (±7.01) grams of carbohydrates, and 11 (±0.40) grams of minerals. The bulk of the calories came from carbohydrates (88 per cent). Proteins furnished 12 per cent of the total calories. Forty-five per cent of the proteins came from animal sources, chiefly fish, and only 38 per cent from rice alone. Vitamin B_1 intake was probably at a minimum without sufficient margin of safety as measured by Cowgill's formula. The most variable factor in the diet was fats, while the least variable were carbohydrates and total energy value.

2. Comparison with the food consumption of rural families showed that the diet of the urban families of Paco furnished less energy, carbohydrates, and minerals, but more fats and a better quality of proteins. When subjected to statistical test only the difference in fat intake was found to be statistically significant. The rural families consumed more rice, but less meat, fish, and eggs, milk and dairy products, and sweet and fatty foods. On the whole the urban families were better fed than the rural families.

3. The daily consumption of sugar per capita was determined. An average daily intake of 18 grams per capita was consumed by the families of Paco, a value which is greater than any of the values obtained for the rural families with the exception of those families residing in Calauan, Laguna Province.

4. The food cost per adult male, which averaged 17 centavos, decreased in amount with the increase in household size. The proportion of money spent for cereals decreased at the higher

cost levels, while that spent for meat, fish, and eggs, and fruits and vegetables increased. Very little money was spent for milk and dairy products, while a fairly constant amount was spent for sweet and fatty foods at the different levels of food costs.

5. A study of the weight of food in the total income revealed that the proportion of the income spent for food is definitely related to differences of family income. Approximately 80 per cent of the families spent about 50 per cent of their income for food. The superiority of the diets consumed by the families earning higher daily incomes is also shown.

6. A study of two families for one month revealed a close relationship between income, food costs, and nutritive value of the diet.

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'TO HAVE' AND 'TO BE' IN ILOKO

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The English concepts 'to have' and 'to be' have their equivalent in Iloko in two entirely different concepts:

(*a*) To be as a locative, and (*b*) 'To be' without any notion of place.

The first is represented in Iloko by the term *addá* in affirmative sentences, and by the term *awán* in negative sentences. The second is included in the predicate in affirmative sentences, and in the adverb of negation in negative sentences.

(*a*) The first translates in the following various ways:

1. The English auxiliary 'to be,' including the notion of place, and the English expression 'there is.' Examples:

addá ditóy	it is here.
awán idiáy	it is not there.
addá áso	there is a dog, there are dogs.
awán ti púsa	there is no cat, there are no cats.

2. The English auxiliary 'to have.' Examples:

addá ások	I have a dog (literally: there is a dog of mine).
awán ti púsak	I have no cat (literally: there is no cat of mine).

(*b*) The second translates the English auxiliary 'to be,' without any notion of place. Examples:

nañgísit ti áso	the dog is black.
dakkél ti púsa	the cat is big.
saán a puráw ti áso	the dog is not white.
saán a bassít ti púsa	the cat is not small.

We shall now explain these constructions more in detail.

"ADDÁ" AND "AWÁN"

1. REPRESENTING "TO BE"

The English concepts 'to be somewhere,' 'there is,' 'there was,' and 'not to be somewhere,' 'there is not,' 'there was not,' are rendered into Iloko by *addá* and *awán*, respectively.

As a general rule, *addá* and *awán* precede the subject.

A. *Addá:*

a. When the subject is indefinite, it follows the term *addá* immediately. Examples:

addá áso	there is a dog, there are dogs.
addá árak	there is wine.
addá táo	there is a man, there are men.
addá danúm	there is water.
addá bassít	there is a small one, there are small ones.
addá naíñgel	there is a strong one.
addá duá	there are two.
addá agságad	somebody sweeps, some people sweep (there is, there are who sweep).
addá agayáb	somebody calls, some people call.
addá mayát	somebody is willing, some are willing.
addá immáy	somebody came, some people came.
addá awán	some are absent, somebody is absent, some are not there.

b. When the subject is definite, the nominative of the article is placed between *addá* and the subject; however, when the subject is a personal pronoun or includes a demonstrative, no article is used, except *ni* which may occur before demonstrative pronouns. Examples:

addá ti áso	the dog is there.
addá ti árak	the wine is there.
addá ti táo	the man is there.
addá ti ások	my dog is there.
addá dagití áso	the dogs are there.
addá dagití baláy	the houses are there.
addá dagití piñggánmo	your plates are there.
addá ni Luís	Lewis is there.
addá ni ulitégko	my uncle is there.
addá da áma ken ína	my father and my mother are there.
addá da Ana	Ann and her husband are there.
addá ti bassít	the small one is there.
addá ti naíñgel	the strong one is there.
addá dagití duá	the two are there.
addá ti agságad	the one who sweeps is there.
addá dagití agayáb	those who call are there.
addá dagití mayát	those who are willing are there.
addá ti immáy	the one who came is there.
addá dagití awán itáy	those who were absent just now are there.

addáka	there you are.
addákami	we are here, here we are.
addá	he, she, it is there.
addá daytóy n̄ga áso	this dog is here.
addá daydí kallogón̄gko	that hat of mine is there.
addá dagití médias	those stockings are there.
addá ni daytóy	this one is there.
addá ni daydiáy	that one is there.

B. *Awán:*

a. When the subject is indefinite, *awán* is followed by the ligature *ti,* except in a few cases which have to be learned by use. Examples:

awán ti áso	there is no dog, there are no dogs.
awán ti árak	there is no wine.
awán ti táo	there is no man, there are no men.
awán ti danúm	there is no water.
awán ti bassít	there is no small one, there are no small ones.
awán ti naín̄gel	there is no strong one.
awán ti duá	there are no two.
awán ti agságad	nobody sweeps (literally: there is nobody who sweeps).
awán ti agayáb	nobody calls.
awán ti mayát	nobody is willing.
awán ti immáy	nobody came.
awán ti awán	they are all there (literally: there is nobody who is not there).
awán sabáli	there are no others, there is nothing else.

b. When the subject is definite, the nominative of the article is used in the same way and with the same restrictions as stated under *addá;* however, when the subject requires the article *ti* in the singular, the use of one of the forms of the demonstratives or articles *daytáy* or *daydí,* or the construction of special rule 1, is necessary in order to distinguish the definite form from the indefinite. Examples:

awán di áso	that dog is not there.
awán tay árak	that wine is not there.
awán tay táo	that man is not there.
awán di ások	that dog of mine is not there.
awán dagití áso	the dogs are not there.
awán dagití baláy	the houses are not there.
awán dagití pin̄ggánmo	your plates are not there.
awán ni Luís	Lewis is not there.
awán ni ulitégko	my uncle is not there.
awán da áma ken ína	my father and my mother are not there.

awán da Ana	Ann and her husband are not there.
awán tay bassít	that small one is not there.
awán di naíñgel	that strong one is not there.
awán dagití duá	the two are not there.
awán dagití agayáb	those who call are not there.
awán dagití mayát	those who are willing are not there.
awán tay immáy	that one who came is not there.
awán dagití awán itáy	those who were absent just now are not there.
awánka	are you not there?
awánkami	we were not there.
awán	he, she, it is not there.
awán daytóy ñga áso	this dog was not there.
awán daydí kallogóñgko	that hat of mine is not there.
awán dagidí médias	those stockings are not there.
awán ni daytóy	this one was not there.
awán ni daydiáy	that one is not there.

NOTE 1.—When the name of the place is expressed and: 1. The subject is indefinite, the latter always precedes the former; 2. The subject is definite: *a.* If it is a personal pronoun, either expressed or understood, it is always joined to *addá* and *awán* immediately. *b.* If it is not a personal pronoun, it is ordinarily followed (A), sometimes preceded (B) by the name of the place, according to the context; when the name of the place is a personal pronoun, however, or an adverb of place, it more often precedes the definite subject (C).

To avoid equivocations, it is often more correct to use the construction of special rule 1, especially when the name of the place has to precede the definite subject, and is neither a personal pronoun nor an adverb of place. Examples:

1. *addá áso idiáy baláy*	there is a dog in the house, there are dogs in the house.
addá naíñgel ití burnáy	there is a strong one in the jar.
addá púsa ditóy	there is a cat here, there are cats here.
addá táo idiáy	there is a man there, there are men there.
addá mayát idiáy dáya	there is one in the east who is willing, there are some in the east who are willing.
addá agayáb ditá	somebody calls there, some people call there.
addá bassít ití rabáw ti lamisáan	there is a small one on the table, there are small ones on the table.
addá áso kaniák	there is a dog with me, there are dogs with me.
addá danúm kenkuána	there is water with him.
awán ti áso idiáy baláy	there is no dog in the house, no dogs are in the house.

awán ti naíñgel ití burnáy	there is no strong one in the jar.
awán ti púsa ditóy	no cat is here, there are no cats here.
awán ti táo idiáy	there are no men there, nobody is there.
awán ti mayát idiáy dáya	nobody in the east is willing.
awán ti agayáb ditá	nobody calls there.
awán ti bassít ití rabáw ti lamisáan	there is no small one on the table, no small ones are on the table.
awán ti áso kaniák	there is no dog with me.
awán ti danúm kenkuána	there is no water with him.
2. a. *addáak ditóy*	I am here.
addáka idiáy baláy	you were in the house.
addá idiáy baláy ti áso	it is in the kennel.
addákami iti unég	we are inside.
addáda idiáy baláy dagití immáy idí kalmán	they are in the house of those who came yesterday (this sentence might also mean: those who came yesterday are in the house; to avoid any equivocation, it will be better to use the construction of special rule 1 for the latter meaning).
dagití immáy idí kalmán addáda idiáy baláy	those who came yesterday are in the house.
addá idiáy baláy ti immáy idí kalmán	he is in the house of the one who came yesterday (or, the one who came yesterday is in the house, which should rather be translated as in the next example).
ti immáy idí kalmán addá idiáy baláy	the one who came yesterday is in the house.
awának idiáy idí kalmán	I was not there yesterday.
awánkat ta	are you not there?
awán idiáy baláy ti áso	it is not in the kennel.
awánkami ití unég	we were not inside.
awánda idiáy baláy dagití immáy idí kalmán	they are not in the house of those who came yesterday (See example with *addá*).
dagití immáy idí kalmán awánda idiáy baláy	those who came yesterday are not in the house.
awán idiáy baláy ti immáy idí kalmán	he is not in the house of the one who came yesterday (See example with *addá*).
ti immáy idí kalmán awán idiáy baláy	the one who came yesterday is not in the house.

b. *addá ti asó idiáy baláy* (A)	the dog is in the house.
addá ti naíñgel ití burnáy (A)	the strong one is in the jar.
addá ti bassít ití rabáw ti lamisáan (A)	the small one is on the table.
addá ken Juán daydí asó (B)	that dog is with John.
addá idiáy dáya ti mayát (B)	the one who is willing is in the east (this sentence is more or less ambiguous, as it might also mean: he is at the east of the one who is willing; therefore the next sentence is better).
ti mayát addá idiáy dáya (Special rule)	the one who is willing is in the east.
addá ti mayát idiáy dáya (no name of place)	the one in the east who is willing is there (this sentence is ambiguous, as it may also mean: the one who is willing is in the east; therefore the next sentence is better).
ti mayát idiáy dáya addá (Special rule)	the one in the east who is willing is there.
addá ti immáy idiáy baláy (no name of place)	the one who came to the house is there (or, the one who came is in the house; an ambiguous sentence).
ti immáy idiáy baláy addá (Special rule)	the one who came to the house is there.
ti immáy addá idiáy baláy (Special rule)	the one who came is in the house.
awán táy áso idiáy baláy (A)	that dog is not in the house.
awán táy naíñgel ití burnáy (A)	that strong one is not in the jar.
awán táy bassít ití rabáw ti lamisáan (A)	that small one is not on the table.
awán ken Juán daydí áso (B)	that dog is not with John.
awán idiáy dáya ti mayát (B)	the one who is willing is not in the east (See example with *addá*).
ti mayát awán idiáy dáya (Special rule)	the one who is willing is not in the east.
awán tay mayát idiáy dáya (no name of place)	the one in the east who is willing is not there (See example with *addá*).
ti mayát idiáy dáya awán (Special rule)	the one in the east who is willing is not there.
awán tay immáy idiáy baláy (no name of place)	the one who came to the house is not there (See example with *addá*).
ti immáy idiáy baláy awán (Special rule)	the one who came to the house is not there.
ti immáy awán idiáy baláy (Special rule)	the one who came is not in the house.

addá ditóy ti púsa (stress on the place) or *addá ti púsa ditóy* (stress on the cat) (C)	the cat is here.
addá ditá tay inbagámi (C)	what we told you is there.
addá tay inbagámi ditá means:	what we told you there is (here).
addá kaniák ti áso (stress on *kaniák*) *or addá ti áso kaniák* (stress on the dog) (C)	the dog is with me.
addá kenkuána dagití líbro or *addá dagití libro kenkuána* (C)	the books are with him.
addá kenká ti inálami (C)	what we took is with you.
addá ti inálami kenká means:	what we took from you is there.
awán ditóy ti púsa (C)	the cat is not here.
awán ti púsa ditóy means:	there is no cat here (indefinite).
awán ditá tay inbagámi (C)	what we told you is not there.
awán tay inbagámi ditá means:	what we told you there is not (here).
awán kaniák ti áso (C)	the dog is not with me.
awán ti áso kaniák means:	there is no dog with me (indefinite).
awán kenkuána dagití líbro (stress on *kenkuána*) or *awán dagití líbro kenkuána* (stress on the books) (C)	the books are not with him.
awán kenká ti inálami (C)	what we took is not with you.
awán ti inálami kenká means:	we took nothing from you or what we took from you is not there.

SPECIAL RULES

1. *a.* Sometimes the definite subject precedes everything, in which case it is used as an apposition, and it has to be repeated in the rest of the sentence, either by itself or by a personal pronoun. This construction is generally allowed, and sometimes it is more elegant; besides, the subject is obviously more emphasized. Only daily practice can teach the student when it should be used or when it is convenient to use it. Examples:

ti áso addá	the dog, he is there.
dagití baláy addáda	the houses, they are there.
siák addáak ditóy	I, I am here.
siká addáka idiáy baláy	you, you are in the house.
ti áso addá idiáy baláy	the dog, he is in the house.
ti áso addá kaniák	the dog, he is with me.
ti púsa addá ditóy	the cat, she is there.
dagití baláy awánda	the houses, they are not there.
ti inálami awán kenká	what we took is not with you.
dagití líbro awánda kenkuána	the books, they are not with him.

b. This construction has to be used with *awán,* when the subject is a singular which requires the definite article *ti* (A),

and in some other cases, with either *addá* or *awán,* when the regular construction has another meaning or is at least ambiguous (B). Examples:

ti áso awán (A)	the dog, he is not there.
ti táo awán	the man, he is not there.
ti immáy awán	the one who came, he is not there.
ti naíñgel awán	the strong one, it is not there.
ti ások awán	my dog, he is not there.
ti bassít awán	the small one, it is not there.
ti áso awán idiáy baláy	the dog, he is not in the house.
ti naíñgel awán iti burnáy	the strong one, it is not in the jar.
ti bassít awán ití rabáw ti lamisáan	the small one, it is not on the table.
ti immáy addá idiáy baláy (B)	the one who came, he is in the house.
dagití immáy idí kalmán addáda idiáy baláy	those who came yesterday, they are in the house.

2. If special emphasis has to be placed on the subject, it may precede everything; in this case it has to be followed by the ligature *ti.* Examples:

áso ti addá	a dog is what is there (or, dogs are what are there).
ti áso ti addá	the dog is what is there.
dagití baláy ti addá	the houses are what are there.
da Ána ti addá	Ann and her husband are those who are there.
siák ti addá ditóy	I am the one who is here.
ti áso ti addá idiáy baláy	the dog is what is in the house.
ti púsa ti addá kaniák	the cat is what is with me.
dagití immáy idí kalmán ti addá idiáy baláy	those who came yesterday are those who are in the house.
ti dakkél ti addá idiáy	the large one is what is there.
áso ti awán	a dog is what is not there (or, dogs are what are not there).
ti áso ti awán	the dog is what is not there.
ti immáy ti awán	the one who came is the one who is not there.
ti bassít ti awán	the small one is the one who is not there.
ti inálami ti awán kenká	what we took is what is not with you.
dagití líbro ti awán kenkuána	the books are what are not with him.
ti mayát ti awán idiáy dáya	the one who is willing is the one who is not in the east.
ti mayát idiáy dáya ti awán	the one in the east who is willing is the one who is not there.

2. REPRESENTING 'TO HAVE'

The English concepts 'to have' and 'not to have' are rendered into Iloko by *addá* and *awán*, respectively. As a general rule, *addá* and *awán* precede the Iloko term which translates the English subject.

A. *Addá:*

a. When the Iloko subject (corresponding to the English object) is indefinite, it finds its place between *addá* and the Iloko term which translates the English subject; no article is used between *addá* and the Iloko subject. When the Iloko subject is a substantive without possessive or genitive, the Iloko term which translates the English subject is either in the genitive or in the oblique (examples 1 to 7); otherwise, it is in the oblique (examples 8 to 16); when the Iloko term which translates the English subject is a personal pronoun, the genitive is of better standing than the oblique (examples 1 to 4); in other cases, the contrary is true (examples 5 to 7). (See note 2.) Examples:

1. *addá ások* or *addá áso kaniák*	I have a dog (literally; There is a dog of mine, or: There is a dog with me).
2. *addá árakko* or *addá árak kaniák*	I have wine.
3. *addá danúmmo* or *addá danúm kenká*	you have water.
4. *addá baláymi* or *addá baláy kadákami*	we have a house.
5. *addá apúy ití kosinéro* or *addá apúy ti kosinéro*	the cook has fire.
6. *addá suáko ken Juán* or *addá suáko ni Juán*	John has a pipe (or, pipes).
7. *addá kabáyo ken gayyémko* or *addá kabáyo ni gayyémko*	my friend has a horse (or, horses).
8. *addá suákok kenkuána*	he has a pipe (or, pipes) of mine.
9. *addá ásomi kadakuáda*	they have a dog (or, dogs) of ours.
10. *addá kabáyo ni Juán kaniák*	I have one (or, some) of John's horses.
11. *addá duá kadákami*	we have two.
12. *addá naíñgel kadakuáda*	they have a strong one.
13. *addá talló ken Ána*	Ann has three.
14. *addá bassít ití allawági*	the carpenter has a small one (or, small ones).
15. *addá kadákami*	we have some.
16. *addá ken gayyémmi*	our friend has some.

NOTE 2. Daily practice must teach the student when to use the genitive and when the oblique with substantives that are not accompanied by a possessive or a genitive. It may be said, in general, that one should use the genitive, whenever one wants to indicate real ownership or customary existence with the person or thing that has the object in question, while one should use the oblique when indicating simple existence for the time being. For example: I have a dog, my own dog: *addá ások;* there is rice in the box where it is kept usually: *addá bagásna,* it (the box) has rice, contains rice, there is rice in it; a rice field is covered with rice: *addá págayna,* it (the field) has rice, there is rice on it. But: I have a dog that came to me, not my own dog: *addá áso kaniák;* there is rice on the table, while it should be in the box: *addá bagás kenkuána,* it (the table) has rice, there is rice on it; there is rice scattered over the ground: *addá págay kenkuána,* it (the ground) has rice, there is rice on it.

This distinction can only be made, of course, when both constructions are allowed; to say: he has, he is the owner of a small one, one has to say: *addá bassít kenkuána,* because *addá bassítna* would be grammatically wrong.

It should further be noted, and this may be seen at first sight if one looks at the examples which have been given already and which will be given by and by, that this construction with the oblique is identical with that given under paragraph 1 (note 1), when the name of the place is expressed: *addá áso kaniák,* there is a dog with me, I have a dog. This confirms our statement about the Iloko concept *addá,* namely: that it represents 'to be' as a locative, and so represents indifferently both the English "to be somewhere, there is, there are" and the English "to have."

b. When the Iloko subject (corresponding to the English object) is definite, it finds its place mostly after *addá* (examples 6 to 7, 12), except when the Iloko term which translates the English subject is a personal pronoun, in which case the Iloko subject finds its place generally at the rear (examples 1 and 2, 9 and 10, 13 and 14); however, much depends on the context. The nominative of the definite article precedes the Iloko subject (examples 1 to 8); however, when the Iloko subject contains a demonstrative, no article is used (examples 9 to 12), except ***ni,*** which may occur before demonstrative pronouns (examples 13 and 14). The Iloko term which translates the English subject is always in the oblique. Examples:

1. *addá kaniák ti áso*	I have the dog.
2. *addá kaniák dagití áso*	I have the dogs.
3. *addá kaniák ti árak* or *addá ti árak kaniák*	I have the wine.
4. *addá kenká dagití baláy* (stress on *kenká*) or *addá dagití baláy kenká* (stress on *dagití baláy*)	you have the houses.

5. *addá ken Juán ti suákok* or *addá ti suákok ken Juán*	John has my pipe.
6. *addá ti danúm ití nagálad*	the one who made the fence has the water.
7. *addá dagití áso kadagití gayyém*	the friends have the dogs.
8. *addá ti kallogóñgko ken ulitégko* or *addá ken ulitégko ti kallogóñgko*	my uncle has my hat.
9. *addá kaniák daydí áso*	I have that dog.
10. *addá kaniák daydí kinonám*	I have what you said.
11. *addá dagitóy ken áma* or *addá ken áma dagitóy*	my father has these ones.
12. *addá daydiáy ñga áso káda Luís ñga agasáwa*	Lewis and his wife have that dog.
13. *addá kaniák ni daytóy*	I have this one.
14. *addá kenkuána ni daydiáy*	he has that one.

B. *Awán:*

a. When the Iloko subject is indefinite, *awán* is followed by the ligature *ti* (A), except when the Iloko subject is not expressed (B), and in a few other cases which have to be learned by use (C). For the rest, it follows the same rule as *addá,* under *a.* Examples:

1. *awán ti ások* or *awán ti áso kaniák* (A)	I have no dog (or, dogs).
2. *awán ti árakko* or *awán ti árak kaniák*	I have no wine.
3. *awán ti danúmmo* or *awán ti danúm kenká*	you have no water.
4. *awán ti baláymi* or *awán ti baláy kadákami*	we have no house (or, houses).
5. *awán ti apúy ití kosinéro* or *awán ti apúy ti kosinéro*	the cook has no fire.
6. *awán ti suáko ken Juán* or *awán ti suáko ni Juán*	John has no pipe (or, pipes).
7. *awán ti kabáyo ken gayyémko* or *awán ti kabáyo ni gayyémko*	my friend has no horse (or, horses).
8. *awán ti duá kadakamí*	we have no two.
9. *awán ti naíñgel kadakuáda*	they have no strong one.
10. *awán ti talló ken Ána*	Ann has no three.
11. *awán ti bassít ití allawági*	the carpenter has no small one.
12. *awán ti suákok kenkuána*	he has none of my pipes.
13. *awán ti ásomi kadakuáda*	they have none of our dogs.
14. *awán ti kabáyo ni Juán kaniák*	I have none of John's horses.
15. *awán kadákami* (B)	we have none.
16. *awán ken gayyémmi*	our friend has none.
awán sabáli kaniák (C)	I have no other ones.

awán tuñgpálna	it has no end.
awán pádana	he has no equal.

b. When the Iloko subject is definite, *awán* follows the same rule as *addá* under *b;* however, when the Iloko subject requires the article *ti*, in the singular, and has no other means of distinction from the indefinite, the use of one of the forms of the demonstratives or articles *daytáy* or *daydí,* or the construction of special rule 1 is necessary, in order to distinguish the definite form from the indefinite. Examples:

1. *awán di áso kaniák*	I have not that dog.
2. *awán kaniák dagití áso*	I have not the dogs.
3. *awán kaniák ti árak* (stress on kaniák) or *awán di árak kaniák* (stress on the wine)	I have not the wine.
4. *awán kenká dagití baláy* or *awán dagití baláy kenká*	you have not the houses.
5. *awán ken Juán ti suákok* or *awán tay suákok ken Juán*	John has not my pipe.
awán ti suákok ken Juán means:	John has none of my pipes (indefinite).
6. *awán tay danúm ití nagálad*	the one who made the fence has not that water.
7. *awán dagití áso kadagití gayyém*	the friends have not the dogs.
8. *awán di kallogóñgko ken ulitégko* or *awán ken ulitégko ti kallógoñgko*	my uncle has not that hat of mine.
10. *awán kaniák daydí kinonám*	I have not what you said.
11. *awán dagitóy ken áma* or *awán ken áma dagitóy*	my father has not these.
12. *awán daydiáy ñga áso káda Luís ñga agasáwa*	Lewis and his wife have not that dog.
14. *awán kenkuána ni daydiáy*	he has not that one.

SPECIAL RULES

1. *a.* The construction of special rule 1 is generally allowed here. Examples:

ti áso addá kaniák	the dog, I have him.
dagití baláy addáda kenká	the houses, you have them.
ti suákok addá ken Juán	my pipe, John has it.
ti áso awán kaniák	the dog, I have him not.
dagití áso awánda kadagití gayyém	the dogs, the friends have them not.
ti kallogóñgko awán ken ulitégko	my hat, my uncle has it not.
dagitóy awánda ken áma	these, my father has them not.

b. This construction has to be used with *awán,* when the Iloko subject is a singular which requires the definite article *ti*, and has no other means of distinction from the indefinite

(A); it must also be used in some other cases with either *addá* or *awán,* when the regular construction has another meaning or is at least ambiguous (B). Examples:

ti danúm awán ití nagálad (A)	the water, the one who made the fence has it not.
ti inálada addá ití kosinéro (B)	what they took, the cook has it.
addá ti inálada ití kosinéro	might mean: what they took from the cook is there.
addá ití kosinéro ti inálada	might mean: the cook of the one they took has it.
ti pinatáyda awán kadagití ubbíñg (B)	what they killed, the children have it not.
awán ti pinatáyda kadagití ubbíñg	might mean: they killed none of the children.
awán kadagití ubbíñg ti pinatáyda	might mean: the children of the one they killed have it not.

2. The construction of special rule 2 is allowed here:

a. When special stress has to be laid on the Iloko subject, in which case it has to be followed by the ligature *ti.* Examples:

áso ti addá kaniák	a dog (or, dogs) is what I have.
ti áso ti addá kaniák	the dog is what I have.
dagití baláy ti addá kenká	the houses are what you have.
ti suákok ti addá ken Juán	my pipe is what John has.
áso ti awán kaniák	a dog (or, dogs) is what I have not.
ti áso ti awán kaniák	the dog is what I have not.
ti kallogóñgko ti awán ken ulitégko	my hat is what my uncle has not.
dagitóy ti awán ken áma	these are what my father has not.
ti danúm ti awán ití nagálad	the water is what the one who made the fence has not.
ti inálada ti awán ití kosinéro	what they took is what the cook has not.
ti pinatáyda ti awán kadagití ubbíñg	what they killed is what the children have not.

b. When special stress has to be laid on the Iloko term which translates the English subject, provided that the Iloko subject be indefinite; in this case the possessive of the 3d person singular is joined to the Iloko subject, while the Iloko term which translates the English subject is in the nominative and is followed by the ligature *ti.* The ligature *ti,* which should follow *awán,* is generally omitted in order to avoid the repetition of the same ligature in one short sentence. Examples:

siák ti addá ásona	I am the one who has a dog (or, dogs).
siká ti addá baláyna	you are the one who has a house (or, houses).

dagití gayyém ti addá suákona	the friends are those who have a pipe (or, pipes).
siák ti awán ásona	I am the one who has no dog (or, dogs).
ni ulitégko ti awán kallogóñgna	my uncle is the one who has no hat (or, hats).
ti nagálad ti awán danúmna	the one who made the fence is the one who has no water.
ti kosinéro ti awán inálana	the cook is the one who took nothing.
dagití ubbíñg ti awán pinatáyda	the children are those who killed nothing.
dakayó ti awán ánusna	you are those who have no patience.
isúda ti awán ásona	they are those who have no dog (or, dogs).

3. SYNOPSIS

AFFIRMATIVE

Indefinite

TO BE	TO HAVE
addá áso: there is a dog.	*addá ások:* I have a dog. or *addá áso kaniák,* etc.

Definite

addá ti áso: the dog is there, etc.	*addá kaniák ti áso:* I have the dog, etc.

NEGATIVE

Indefinite

addá áso: there is a dog.	*awán ti ások:* I have no dog. or *awán ti áso kaniák,* etc.

Definite

awán di áso: the dog is not there, etc.	*awán kaniák ti áso:* I have not the dog, etc.

SPECIAL RULE 1

AFFIRMATIVE

ti áso addá: the dog, he is there, etc.	*ti áso addá kaniák:* the dog, I have him, etc.

NEGATIVE

ti áso awán: the dog, he is not there, etc.	*ti áso awán kaniák:* the dog, I have him not, etc.

SPECIAL RULE 2

AFFIRMATIVE

áso ti addá: a dog is what is there, etc.

áso ti addá kaniák: a dog is what I have, etc.

siák ti addá ásona: I am the one who has a dog, etc.

NEGATIVE

áso ti awán: a dog is what is not there, etc.

áso ti awán kaniák: a dog is what I have not, etc.

siák ti awán ásona: I am the one who has no dog, etc.

'TO BE' INCLUDED IN THE PREDICATE

The English concepts 'to be' and 'not to be' without any notion of place are simply included in the predicate and in the adverb of negation, respectively.

NOTE 3. All the constructions noted before under special rule 2 should be included here, as will be seen by some of the examples.

(A). As a general rule the predicate precedes the subject to which it is connected by the nominative of the definite article (examples 1 to 16); however, when the predicate is a personal pronoun, expressed or understood (examples 17 to 28), or includes a demonstrative (examples 29 to 34), no article is used, except *ni* which may occur before demonstrative pronouns (example 35). When the subject is a personal pronoun and the predicate consists of a substantive accompanied by an attribute, the personal pronoun is joined to the term which precedes (examples 18 to 19, 27). Examples:

1. *nalamíis ti danúm*	(the) water is cold.
2. *natakrót ti ugsá*	the deer is timid (or, deer are timid.
3. *natañgsít dagití balasáñg*	(the) girls are proud.
4. *naturéd dagití soldádo*	(the) soldiers are bold.
5. *nakottóñg dagití kabáyom*	your horses are thin.
6. *nalukmég dagití bákayo*	your cows are fat.
7. *adayó ti ílimi*	our town is far.
8. *naánus ti gayyémmo*	your friend is kind.
9. *natáyag ti pinatáyda*	the one they killed was tall.
10. *babassít dagití inálada*	what they took were small.
11. *bassít ti addá kenkuána*	what he has is small (or, he has little).
12. *sipipítak dagití sapátosta*	our shoes are covered with mud.
13. *gayyémko ni Juán*	John is my friend.

14. *kaádalko ni kasinsínko*	my cousin is my classmate.
15. *kabúsorko da Ána*	Ann and her husband are my enemies.
16. *nasiñgpét a babái ni Juána*	Joan is a virtuous woman.
17. *nasiñgpétak*	I am virtuous.
18. *nasiñgpétka a bálasañg*	you are a virtuous girl.
19. *balasáñgka a natañgsít*	you are a proud girl.
20. *nagagét*	he is diligent.
21. *nasadút a nuáñg*	it is a lazy carabao.
22. *áso a natakrót*	it is a timid dog.
23. *bábuy a nadalús*	it is a clean pig.
24. *nalaíñgkami*	we are clever.
25. *babbarótayo*	we are young men.
26. *aggayyémta*	we are friends.
27. *soldádokayo a natakrót*	you are timid soldiers.
28. *bulsékda*	they are blind.
29. *natadém dagitóy*	these are sharp.
30. *naúyoñg daytá áso*	that dog is fierce.
31. *baknáñg daydí gayyémyo*	that friend of yours is rich.
32. *nakulbét tay kárne*	that meat was tough.
33. *nagláwa dagitóy a tálonen*	how large are these rice fields!
34. *nakabutbutéñg ta saóm*	that speech of yours is terrible.
35. *napintás ni daytóy*	this one is pretty.
36. *áso ti awán* (Special rule)	a dog is what is not there (or, what is not there is a dog).
37. *ti áso ti addá*	what is there is the dog.
38. *ti áso ti awán kaniák*	what I have not is the dog.
39. *siák ti addá ásona*	the one who has a dog is I.
40. *ti ílimi ti adayó*	what is far is our town.

NOTE 4. We should note down here how the Iloko use *adú*, much, many, and *bassít*, little, few, because these terms form quite an exception to the general rule. As we have seen at the beginning of this paper, the English terms "there is," "to have," are rendered into Iloko by *addá;* here, however, "there is much," "I have much," etc., are often translated into Iloko by simple predicates. To make things clear, we shall give several ways of using *adú* and *bassít* in Iloko sentences referring to many cats, much rice, and few cats, little rice.

1. *adú ti púsa:* there are many cats; *saán ñga adú ti púsa:* there are not many cats.
   adú ti bagás: there is much rice; *saán ñga adú ti bagás:* there is not much rice.
   bassít ti púsa: there are few cats (this may also mean: the cat is small, because *bassít* means either few or small, according to the context); *saán a bassít ti púsa:* there are not few cats (this will nearly always mean: the cat is not small, and consequently should never be used in this connection).
   bassít ti bagás: there is little rice; *saán a bassít ti bagás:* there is not little rice.

2. *adú ti addá a púsa:* there are many cats; *saán n̄ga adú ti addá a púsa:* there are not many cats.
   adú ti addá a bagás: there is much rice; *saán n̄ga adú ti addá a bagás:* there is not much rice.
   bassít ti addá a púsa: there are few cats (this will rarely mean: the cat which is there is small, and consequently it is the best way to translate: there are few cats); *saán a bassít ti addá a púsa:* there are not few cats (this will rarely mean: the cat which is there is not small, and consequently it is the best way to translate: there are not few cats).
   bassít ti addá a bagás: there is little rice; *saán a bassít ti addá a bagás:* there is not little rice.
3. *addá ti adú a púsa:* there are many cats; *awán ti adú a púsa:* there are not many cats.
   addá ti adú a bagás: there is much rice; *awán ti adú a bagás:* there is not much rice.
   addá ti bassít a púsa: there are few cats (this will nearly always mean: the small cat is there, and consequently should never be used in this connection); *awán ti bassít a púsa:* there are not few cats (this will nearly always mean: the small cat is not there, and consequently should never be used in this connection).
   addá ti bassít a bagás: there is little rice; *awán ti bassít a bagás:* there is not little rice.
1. *adú ti púsami:* we have many cats; *saán n̄ga adú ti púsami:* we have not many cats.
   adú ti bagásmi: we have much rice; *saán n̄ga adú ti bagásmi:* we have not much rice.
   bassít ti púsami: we have few cats (this may also mean: our cat is small); *saán a bassít ti púsami:* we have not few cats (this will nearly always mean: our cat is not small).
   bassít ti bagásmi: we have little rice; *saán a bassít ti bagásmi:* we have not little rice.
2. *adú ti addá a púsami:* we have many cats; *saán n̄ga adú ti addá a púsami:* we have not many cats.
   adú ti addá a bagásmi: we have much rice; *saán n̄ga adú ti addá a bagásmi:* we have not much rice.
   bassít ti addá a púsami: we have few cats; *saán a bassít ti addá a púsami:* we have not few cats.
   bassít ti addá a bagásmi: we have little rice; *saán a bassít ti addá a bagásmi:* we have not little rice.
3. *addá ti adú a púsami:* we have many cats; *awán ti adú a púsami:* we have not many cats.
   addá ti adú a bagásmi: we have much rice; *awán ti adú a bagásmi:* we have not much rice.
   addá ti bassít a púsami: we have few cats (this will nearly always mean: our small cat is there); *awán ti bassít a púsami:* we have not few cats (this will nearly always mean: our small cat is not there).
   addá ti bassít a bagásmi: we have little rice; *awán ti bassít a bagásmi:* we have not little rice.

Instead of the possessive *mi*, one may also use the oblique *kadakámi*, as has been stated above: *adú ti púsa kadakamí:* we have many cats, etc., etc.

4. An entirely different meaning is included in the following expressions:

   adú ti púsa n̄ga awán: many cats are not there; *saán n̄ga adú ti púsa n̄ga awán:* not many cats are not there (literally and better: the cats, which are not there, are not many).

   adú ti bagás n̄ga awán: much rice is not there; *saán n̄ga adú ti bagás n̄ga awán:* not much rice is not there.

   bassít ti púsa n̄ga awán: few cats are not there; *saán a bassít ti púsa n̄ga awán:* not few cats are not there (this will nearly always mean: the cat, which is not there, is not small, and consequently should never be used in this connection).

   bassít ti bagás n̄ga awán: little rice is not there; *saán a bassít ti bagás n̄ga awán:* not little rice is not there.

   adú ti púsami n̄ga awán: many of our cats are not there, etc.

   adú ti púsa n̄ga awán kadákami: many cats are not with us, etc.

Among this medley of sentences, we shall now choose which are the best and the least ambiguous; if the student uses the following expressions, he will always talk clear and correct Iloko; if he hears other ones, he will understand them through the preceding table.

1. There are many cats: *adú ti púsa.*
3. There are not many cats: *awán ti adú a púsa.*
1. There is much rice: *adú ti bagás.*
3. There is not much rice: *awán ti adú a bagás.*
2. There are few cats: *bassít ti addá a púsa.*
2. There are not few cats: *saán a bassít ti addá a púsa.*
1. There is little rice: *bassít ti bagás.*
1. There is not little rice: *saán a bassít ti bagás.*
   We have many cats: *adú ti púsami,* etc.
4. Many cats are gone (not there): *adú ti púsa n̄ga awán.*
   Not many cats are gone: *saán n̄ga adú ti púsa n̄ga awán.*
   Much rice is gone: *adú ti bagás n̄ga awán.*
   Not much rice is gone: *saán n̄ga adú ti bagás n̄ga awán.*
   Few cats are gone: *bassít ti púsa n̄ga awán.*
   Not few cats are gone: *adú ti púsa n̄ga awán.*
   Little rice is gone: *bassít ti bagás n̄ga awán.*
   Not little rice is gone: *saán a bassít ti bagás n̄ga awán.*
   Many of our cats are gone: *adú ti púsami n̄ga awán,* etc.
   Many cats are not with us: *adú ti púsa n̄ga awán kadákami,* etc.

(B) As a general rule, the adverb of negation precedes the predicate, which is followed by the subject; the same connections as in (A) are used and with the same restrictions; personal pronouns, however, and possessives are always joined to the adverb of negation. Examples:

1. *saán a nalamíis ti danúm*	(the) water is not cold.
2. *saán a natakrót ti ugsá*	the deer is not timid (or, deer are not timid).
3. *saán a natañgsít dagití balásañg*	(the) girls are not proud.
4. *saán a naturéd dagití soldádo*	(the) soldiers are not bold.
5. *saán a nakottóñg dagití kabáyom*	your horses are not thin.
6. *saán a nalukmég dagití bákayo*	your cows are not fat.
7. *saán ñga adayó ti ílimi*	our town is not far.
8. *saán a naánus ti gayyémmo*	your friend is not kind.
9. *saán a natáyag ti pinatáyda*	the one they killed was not tall.
10. *saán a babassít dagití inálada*	what they took were not small.
11. *saán a bassít ti addá kenkuána*	what he has is not small (or, he has not little).
12. *saán a sipipítak dagití sápatosta*	our shoes are not covered with mud.
13. *saánko a gayyém ni Juán*	John is not my friend.
14. *saánko a kaádal ni kasinsínko*	my cousin is not my classmate.
15. *saánko a kabúsor da Ána*	Ann and her husband are not my enemies.
16. *saán a nasiñgpét a babái ni Juána*	Joan is not a virtuous woman.
17. *saának a nasiñgpét*	I am not virtuous.
18. *saánka a nasiñgpét a balásañg*	you are not a virtuous girl.
19. *saánka a balásañg a natañgsít*	you are not a proud girl.
20. *saán a nagagét*	he is not diligent.
21. *saán a nasadút a nuáñg*	it is not a lazy carabao.
22. *saán ñga áso a natakrót*	it is not a timid dog.
23. *saán a bábuy a nadalús*	it is not a clean pig.
24. *saánkami a nalaíñg*	we are not clever.
25. *saántay a babbaró*	we are not young men.
26. *saánta ñga aggayyém*	we are not friends.
27. *saánkay a soldádo a natakrót*	you are not timid soldiers.
28. *saánda a bulsék*	they are not blind.
29. *saán a natadém dagitóy*	these are not sharp.
30. *saán a naúyoñg daytá áso*	that dog is not fierce.
31. *saán a baknáñg daydí gayyémyo*	that friend of yours is not rich.
32. *saán a nakulbét tay kárne*	that meat was not tough.
33. *saán a naláwa dagitóy a tálon*	these rice fields are not large.
34. *saán a nakabutbutéñg ta saóm*	that speech of yours is not terrible.
35. *saán a napintás ni daytóy*	this one is not pretty.
36. *saán ñga áso ti awán* (Special rule)	it is not a dog that is not there (or, what is not there is not a dog).
37. *saán a ti áso ti addá*	what is there is not the dog.
38. *saán a ti áso ti awán kaniák*	what I have not is not the dog.
39. *saán a siák ti addá ásona*	the one who has a dog is not I.
40. *saán a ti ílimi ti adayó*	what is far is not our town.

NOTE 5. *a.* When the subject is a personal pronoun, and the predicate has a genitive joined to it which is not a possessive, the genitive follows immediately the predicate or the adverb of negation in the shape of a possessive of the 3d person, and the complete genitive is repeated after the subject. Examples:

annáknatayo ti Dios	we are God's children.
anáktayo ti Dios means:	God is our child.
saánnatayo n͠ga apó ni daytá	we are not the grandparents of that one.
saántayo n͠ga apó ni daytá means:	that one is not our grandfather.
saánnakami a kabúsor ni Pédro	we are not Peter's enemies.
saándak a kabsát dagitóy	I am not the brother of these ones.
gayyém datayo dagití kaarróbami	we are the friends of our neighbors.
gayyémtayo dagití kaarróbami means:	our neighbors are our friends.

b. Sometimes, when the subject is a plural, the personal pronoun of the 3d person plural is joined to the predicate or to the adverb of negation, in order to emphasize the latter. Examples:

nakottón͠gda dagití kabáyom	your horses are thin.
natadémda dagitóy	these ones are sharp.
nagláwada dagitóy a tálonen	how large are these rice fields.
saánda a nakottón͠g dagití kabáyom	your horses are not thin.
saánda a natadém dagitóy	these ones are not sharp.
saánda a naláwa dagitóy a tálon	these rice fields are not large.

SPECIAL RULES

1. The construction of special rule 1 is generally allowed here. Examples:

ti danúm nalamíis	the water, it is cold.
dagití balásan͠g natan͠gsítda	the girls, they are proud.
dagití kabáyom nakottón͠gda	your horses, they are thin.
ti ílimi adayó	our town, it is far.
ti gayyémmo naánus	your friend, he is kind.
ti pinatáyda natáyag	the one they killed, he was tall.
ti addá kenkuána bassít	what he has, it is small (or, little).
dagití sapátosta sipipítakda	our shoes, they are covered with mud.
ni Juána nasin͠gpét a babái	Joan, she is a virtuous woman.
siák nasin͠gpétak	I, I am virtuous.
isú nagagét	he, he is diligent.
dakayó soldádokayo a natakrót	you, you are timid soldiers.
dagitóy natadémda	these ones, they are sharp.
dagitóy a tálon nagláwadan	these rice fields, how large they are!
ti saóm nakabutbutén͠g	that speech of yours, it is terrible.
ni daytóy napintás	this one, she is pretty.
ti awán áso	what is not there, it is a dog.

ti addá ti áso	what is there, it is the dog.
ti awán kaniák ti áso	what I have not, it is the dog.
ti addá ásona siák	the one who has a dog, it is I.
ti adayó ti ílimi	what is far, it is our town.
ti danúm saán a nalamíis	the water, it is not cold.
dagití balásañg saánda a natañgsít	the girls, they are not proud.
dagití kabáyom saánda a nakottóñg	your horses, they are not thin.
ti ílimi saán ñga adayó	our town, it is not far.
ti gayyémmo saán a naánus	your friend, he is not kind.
ti pinatáyda saán a natáyag	the one they killed, he was not tall.
ti addá kenkuána saán a bassít	what he has, it is not small (or, little).
dagití sapátosta saánda a sipipítak	our shoes, they are not covered with mud.
ni Juána saán a nasiñgpét a babái	Joan, she is not a virtuous woman.
siák saának a nasiñgpét	I, I am not virtuous.
isú saán a nagagét	he, he is not diligent.
dakayó saánkayo a soldádo a natakrót	you, you are not timid soldiers.
dagitóy saánda a natadém	these ones, they are not sharp.
dagitóy a tálon saánda a naláwa	these rice fields, they are not large.
ti saóm saán a nakabutbutéñg	your speech, it is not terrible.
ni daytóy saán a napintás	this one, she is not pretty.
ti awán saán ñga áso	what is not there, it is not a dog.
ti addá saán a ti áso	what is there, it is not the dog.
ti awán kaniák saán a ti áso	what I have not, it is not the dog.
ti addá ásona saán a siák	the one who has a dog, it is not I.
ti adayó saán a ti ílimi	what is far, it is not our town.

2. The construction of special rule 2 is allowed here, when special emphasis has to be laid on the subject; in this case it has to be followed by the ligature *ti*. Examples:

ti danúm ti nalamíis	the water is what is cold.
ugsá ti natakrót	deer are what are timid.
dagití balásañg ti natañgsít	the girls are those who are proud.
dagití kabáyom ti nakottóñg	your horses are the thin ones.
ti ílimi ti adayó	our town is what is far.
ti pinatáyda ti natáyag	what they killed is what is tall.
ti addá kenkuána ti bassít	what he has is what is small.
ni Juána ti nasiñgpét a babái	Joan is the virtuous woman.
siák ti nasiñgpét	I am the one who is virtuous.
isú ti nagagét	he is the diligent one.
siká ti balásañg	you are the girl.
isú ti nasadút a nuáñg	he is the lazy carabao.
dakamí ti nalaiñg	we are the clever ones.
datá ti aggayyém	we are those who are friends.
dakayó ti soldádo a natakrót	you are the timid soldiers.
ti danúm ti saán a nalamíis	the water is what is not cold.
ugsá ti saán a natakrót	deer are what are not timid.

dagití balásan͠g ti saán a natan͠gsít	the girls are those who are not proud.
dagití kabáyom ti saán a nakottón͠g	your horses are those who are not thin.
ti ílimi ti saán n͠ga adayó	our town is what is not far.
ti pinatáyda ti saán a natáyag	what they killed is what is not tall.
ti addá kenkuána ti saán a bassít	what he has is what is not small.
ni Juána ti saán a nasin͠gpét a babái	Joan is the one who is not a virtuous woman.
siák ti saán a nasin͠gpét	I am the one who is not virtuous.
isú ti saán a nagagét	he is the one who is not diligent.
siká ti saán a balásan͠g	you are the one who is not a girl.
isú ti saán a nasadút a nuán͠g	he is the one who is not a lazy carabao.
dakamí ti saán a nalaín͠g	we are those who are not clever.
datá ti saán n͠ga aggayyém	we are those who are not friends.
dakayó ti saán a soldádo a natakrót	you are those who are not timid soldiers.

NEW OR LITTLE-KNOWN TIPULIDÆ FROM EASTERN ASIA (DIPTERA), XXXIX[1]

By Charles P. Alexander

Of Amherst, Massachusetts

FOUR PLATES

The great majority of the species of crane flies discussed herein were taken in Mount Omei, Szechwan, western China, by Mr. Tsen Bao-chi, native collector for the Reverend Mr. George Meredith Franck. A few others from sources discussed in the text are described. Except where noted to the contrary, the types of the novelties are preserved in my personal collection.

TIPULINÆ

TIPULA GRACILIROSTRIS sp. nov. Plate 1, fig. 1; Plate 2, figs. 25 and 26.

Large (wing, male, over 20 millimeters); frontal prolongation of head very long and slender, without nasus; mesonotal præscutum gray, with three darker brownish gray stripes that are bordered by dark brown; pleura variegated dark brown and yellow; halteres yellow, base of knob extensively darkened; femora back, bases and a broad subterminal ring yellow; tibiæ brownish black, bases yellow; wings light yellow, prearcular and costal portions more saturated; a restricted zigzag light-brown pattern before cord, and darker brown seams and clouds beyond cord; cell 1st M_2 relatively small; male hypopygium with caudal margin of tergite slightly produced into a bifid depressed plate, dorsal surface with black hair brushes; outer dististyle a flattened paddlelike blade; inner dististyle with posterior portion or "heel" produced backward into a point, outer margin with conspicuous black teeth.

Male.—Length, about 21.5 to 22 millimeters; wing, 22 to 23; antenna, about 5; rostrum alone, about 3.

Frontal prolongation of head unusually long and slender, about one and one-half as long as remainder of head, without nasus; front and its prolongation in almost direct alignment with vertex, interrupted only by the very low vertical tubercle;

[1] Contribution from the entomological laboratory, Massachusetts State College.

front dark brownish gray; palpi black. Antennæ with scape obscure yellow, darkened basally; pedicel yellow; flagellum weakly bicolored, brown, bases dark brown; verticils unusually long, exceeding segments; terminal segment a little more than one-third penultimate. Head dark gray, with a narrow, vague, median, brown vitta; anterior vertex a little brightened.

Thorax gray, præscutum with three darker brownish gray stripes that are bordered by dark-brown, median stripe vaguely split by a dusky line, lateral stripes with outer margin darkened; humeral region more yellow-pollinose; lateral margin of præscutum darkened; each scutal lobe with two separate brown areas; mediotergite with a dark central line. Pleura chiefly dark brown, dorsopleural membrane and areas on dorsal sternopleurite and ventral pleurotergite light yellow. Halteres light yellow, base of knob extensively darkened. Legs elongate; coxæ gray; trochanters infuscated, fore pair brighter; femora black, bases narrowly but conspicuously yellow; a broad (2 to 2.5 millimeters) yellow subterminal ring, tips narrowly black; tibiæ brownish black, bases yellow; tarsi black; tibial spur formula 1 : 1 : 2; claws with a small tooth before midlength. Wings (Plate 1, fig. 1) light yellow, prearcular and costal portions deeper yellow; a relatively sparse dark and light brown pattern, producing a zigzag appearance; areas before cord paler, appearing as narrow angular clouds in cells R to 2d A inclusive, cells C and Sc unmarked; beyond cord the pattern darker brown, appearing as narrow seams and marginal darkenings at ends of veins, including a narrow oblique band across radial field from outer end of cell R_2, through cell R_5, becoming confluent behind with seams along medial field; veins yellow, darker in the clouded areas. Squama with a few setæ; trichia of veins beyond cord small and sparse. Venation: R_{1+2} strongly preserved, elongate; vein R_3 sinuous, constricting cell R_3 at about midlength; cell 1st M_2 small; petiole of cell M_1 subequal to m.

Abdomen dark brown, lateral borders of both tergites and sternites narrowly light gray; outer segments uniformly brownish gray. Male hypopygium massive; suture between ninth tergite and ninth sternite incomplete. Ninth tergite (Plate 2, fig. 25, *9t*) massive, median area slightly produced into a bifid glabrous plate, dorsal surface of lobes virtually concealed by brushes of black setæ. Dististyles of peculiar conformation, as shown (Plate 2, fig. 26); outer dististyle, *od*, a flattened paddle-

like blade. Inner dististyle, *id*, with heel portion produced backward into a slender lobe, outer margin with conspicuous black teeth. Ninth sternite with a small darkened knob on mesal margin beneath. Eighth sternite unarmed.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, White Cloud Temple, altitude 9,000 feet, June 12, 1937 (*Tsen*). Paratopotype, male, White Cloud Temple to summit, 11,000 feet, June 9, 1937 (*Tsen*).

I am inclined to believe that this very distinct and remarkable fly is correctly placed in the subgenus *Sinotipula* Alexander [2] but this is not entirely certain. The very long and slender frontal prolongation of the head, without nasus, is very different from the condition found in other species of *Tipula* known to me, being rather suggestive of the genus *Clytocosmus* Skuse, of eastern Australia.[3] Moreover, the inner dististyle of the male hypopygium is not very dissimilar from that of *Clytocosmus*, but the antennæ, with unusually long flagellar verticils, show that the present fly is a true *Tipula* though very distinct.

TIPULA (SCHUMMELIA) BILOBULA sp. nov. Plate 1, fig. 2; Plate 2, fig. 27.

Mesothorax orange to yellow, unmarked; femora brown, tips narrowly brownish black; wings weakly tinged with brown, cells C and Sc, with stigma, abruptly dark brown; Sc_1 indicated by a weak spur, Sc_2 long; cell 1st M_2 small; cell 2d A long and narrow; abdominal tergites yellow, segments six to eight, inclusive, blackened; male hypopygium with tergite deeply notched medially; eighth sternite with posterior margin bearing two widely separated, slender lobes; ædeagus profoundly trifid on distal two-thirds.

Male.—Length, about 13 millimeters; wing, 15; antennæ, about 3.2.

Frontal prolongation of head obscure yellow, darker on sides; nasus distinct; palpi with basal two segments pale, outer segments darker. Antennæ relatively short, if bent backward extending nearly to wing root; basal three segments yellow, succeeding two or three segments vaguely bicolored, basal enlargement black, remainder brown, outer segments uniformly black. Front and anterior vertex buffy, posterior vertex abruptly gray; a capillary brown median vitta on vertex, extending from low vertical tubercle to occiput.

[2] Philip. Journ. Sci. 57 (1935) 94–100.

[3] Alexander, Proc. Linn. Soc. New South Wales 57 (1932) 13–23, figs. 1, 2.

Pronotum infuscated, lateral portions, with propleura, light yellow. Mesonotum almost uniformly orange, præscutal stripes not or scarcely differentiated against ground; præscutum with vestiture exceedingly reduced to virtually lacking. Pleura yellow. Halteres elongate, yellow, knobs dark brown. Legs long and slender; coxæ and trochanters yellow; femora brown, bases restrictedly yellow, tips narrowly brownish black; tibiæ and tarsi pale brown; tibial spur formula 1 : 2 : 2; claws small, with a reduced spine. Wings (Plate 1, fig. 2) with a weak brown tinge, cells C and Sc, together with stigma, abruptly dark brown; prearcular field paler brown; longitudinal veins narrowly and vaguely seamed with darker; veins brown; obliterative areas restricted. Wings long-petiolate; veins beyond cord with dense macrotrichia of moderate length, virtually lacking on R_{1+2}; squama with setæ. Venation; Sc_1 indicated by a weak spur and approximation of veins Sc and C, Sc_2 long-extended beyond this spur; Rs about one-half longer than m-cu; cell 1st M_2 small; cell M_1 deep, exceeding three times its petiole; M_{3+4} nearly as long as basal section of M_3; cell 2d A long and narrow.

Abdominal tergites yellow, outer segments more obscure, narrowly darkened medially; sternites clear yellow; subterminal three segments blackened; hypopygium obscure yellow. Male hypopygium (Plate 2, fig. 27) with tergite, *9t*, separated from sternite, *9s;* basistyle, *b*, entire, outer margin produced into a blade that is obtusely rounded at tip. Ninth tergite, *9t*, extensive, about as long as wide, caudal margin with a deep median notch; lateral lobes obtusely truncated, outer lateral angles produced into subacute blades. Outer dististyle small, subcylindrical. Inner dististyle, *id*, extensive, posterior portion at base produced into a slender pale lobe. Eighth sternite, *8s*, narrowed outwardly, apex with a pair of slender, fingerlike lobes, widely separated on midline. Ædeagus simple on basal third, thence split into three long slender rods.

Habitat.—Siam.

Holotype, male, Chiengmai (Mrs. McKean); through Professor T. D. A. Cockerell.

Tipula (*Schummelia*) *bilobula* is quite distinct from all other regional species so far made known. The condition of the ædeagus, which is divided into three branches for more than one-half the entire length, provides a character not hitherto known to me in the genus though equalled or approached in the subfamily Cylindrotominæ.

TIPULA (SCHUMMELIA) CUMULATA sp. nov. Plate 1, fig. 3; Plate 2, fig. 28.

General coloration yellow, præscutum with three reddish brown stripes that are narrowly bordered by darker brown, median stripe split by a capillary brown vitta; flagellum black; nasus small to subobsolete; mediotergite weakly infuscated, with a pale median line; femora obscure yellow, passing into brown; tibiæ and tarsi black; wings cream-yellow, heavily clouded with pale brown; Rs subequal to m-cu; abdomen yellow, outer tergites darkened; hypopygium black; male hypopygium with tergite heavily blackened on posterior border; outer dististyle elongate, weakly dilated at near midlength; inner dististyle long-oval, beak very slender; eighth sternite with abundant long yellow setæ on posterior border.

Male.—Length, about 12 millimeters; wing, 14; antenna, about 3.5.

Frontal prolongation of head relatively long, nearly equal in length to remainder of head, yellow above, darker on sides; nasus small to subobsolete; basal three palpal segments obscure yellow, terminal segment black. Antennæ with basal two segments yellow, flagellum black. Head orange, paling to yellow in front.

Pronotum infuscated, more yellow on sides. Mesonotal præscutum yellow, with three reddish brown stripes that are narrowly bordered by darker brown, median stripes further divided by a brown median vitta; scutum yellow, lobes variegated with reddish brown; scutellum obscure yellow, parascutella slightly more darkened; mediotergite weakly infuscated, with a vague broad median yellow line. Pleura yellow, slightly variegated with darker, including a small dark-brown spot on extreme dorsal anepisternum; paler brown washes on ventral anepisternum, dorsal pteropleurite, and meron; ventral pleurotergite swollen, whitish. Halteres with stem weakly infuscated, knob light yellow. Legs with coxæ light yellow; trochanters testaceous yellow; femora obscure yellow at bases, passing into brown, tips broadly black; tibiæ and tarsi black. Wings (Plate 1, fig. 3) with ground color cream-yellow, heavily clouded with pale brown; prearcular field and cells C and Sc more saturated yellow; stigma dark brown; brown washes before cord, in outer end of cell R_2, cell 1st M_2 and beyond, most of cell R, and extensive areas in cells M, Cu, 1st A, and 2d A; the pale ground areas contrast conspicuously with the brown, the chief being before and beyond stigma; outer medial cells and base of cell 1st M_2; cell M_1 more whitened;

base and apex of cells M and Cu; major areas at base and apex of both anal cells, tip of vein 1st A surrounded by pale, tip of vein 2d A subtended on either side by pale, actual tip darkened; veins dark, restrictedly pale in certain of ground areas. Macrotrichia on basal half of vein R_{1+2}; squamal setæ few. Venation: Rs subequal to or a little longer than m-cu; cell M_1 deep, its petiole a little longer than m.

Abdomen yellow, outer tergites more obscure; hypopygium blackened. Male hypopygium with tergite (Plate 2, fig. 28, 9*t*) transverse, caudal margin broadly emarginate, very heavily blackened and sclerotized both on caudal and ventral faces; a sublateral spine on either side beneath and a blunt lobe on either side of median incision. Basistyle with a blackened lobe on mesal face. Outer dististyle, *od,* unusually long, slightly dilated and angularly bent at near midlength. Inner dististyle, *id,* long-oval, beak very slender; a long pale dorsal flange. Gonapophyses appearing as slender, gently curved, black spines. Eighth sternite, 8*s*, extensive, caudal margin very gently emarginate, with abundant long yellow setæ, these lacking only on extreme median area.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, White Cloud Temple, altitude 9,000 feet, June 12, 1937 (*Tsen*). Paratopotype, male.

Tipula (*Schummelia*) *cumulata* is very distinct from its nearest described ally, *T.* (*S.*) *honorifica* Alexander, of the Szechwan-Tibet Border, differing in the coloration, wing, and leg pattern, and in the structure of the male hypopygium.

TIPULA (TIPULODINA) CANTONENSIS sp. nov.

General coloration light gray, præscutum with three conspicuous brown stripes; flagellum weakly bicolored; pleura yellow, sparsely pruinose; tibiæ black, midtibiæ with a broad white ring on distal half, posterior tibiæ with two broad white rings; tarsi chiefly white; wings narrow, grayish, costal and subcostal cells brown; a relatively heavy brown pattern, including conspicuous wing tip in outer radial field; cell M_1 relatively shallow, outer end of cell 1st M_2 truncate, cell M_4 wide at base.

Female.—Length, about 16 millimeters; wing, 14.2.

Frontal prolongation of head moderately long, obscure brownish yellow; nasus short and stout; palpi black. Antennæ with scape pale yellow, pedicel very little darker; flagellum weakly bicolored, bases brown, apices more broadly paler brown; outer segments uniformly brownish black; segments longer than in

hopiensis (male). Head brownish gray, clearer gray in front; anterior vertex wide, with a tiny median tubercle and lower, less distinct roughenings behind each antennal fossa.

Pronotum obscure yellow, conspicuously dark brown medially. Mesonotal præscutum with ground color light gray, with three conspicuous brown stripes, median stripe with a faintly darker median vitta on anterior half; posterior interspaces obscured; scutal lobes grayish; posterior sclerites of notum clear dark gray, mediotergite lighter gray on sides. Pleura yellow, sparsely pruinose. Halteres brown, base of stem paler. Legs with coxæ yellow, sparsely pruinose; trochanters yellow; forelegs broken; middle femora obscure yellow, tips narrowly brownish black; tibiæ black, with a broad white ring on distal half, this exceeding twice black tip; basal half of basitarsi black, apical half and succeeding three segments white, terminal segment broken; posterior femora brown, base paler, apex passing into brownish black; tibiæ black, with a broad white ring on both basal and apical half, basal ring subequal to intervening black ring, outer white annulus about one-half wider, exceeding four times blackened apex; basitarsi blackened on proximal fourth or less, remainder and succeeding segments white, terminal segment broken. Wings narrow, long-petiolate at base; ground color grayish, prearcular field and an area just beyond cord a little more whitish hyaline; a heavy brown pattern, as follows: Wing tip in outer radial field, basal third of cell R_2 pale; broad seams on anterior and posterior cords and along distal section of vein Cu_1, this band along cord broken at M; outer end of cell 1st M_2 and veins issuing from it more narrowly seamed; cells C and Sc_2 brown, cell Sc and stigma dark brown; veins dark brown, paler in ground areas. Venation: Cell M_1 relatively shallow, less than three times its petiole; m transverse so cell 1st M_2 is truncate at outer end; m-cu long, cell M_4 wide at base; cell 2d A reduced to a narrow strip, shorter than in *hopiensis*.

Abdominal tergites brown, somewhat darker medially; caudal and lateral borders of segments narrowly pale; outer tergites more pruinose; sternites obscure yellow; cerci relatively stout, upcurved, black, obtuse tips narrowly reddish.

Habitat.—China (Kwangtung).

Holotype, female, Canton, Honam Island, P'an-yu District, on wooded hill, July 26, 1933 (*Tinkham*). Type in collection of Lingnan University, Canton.

Tipula (*Tipulodina*) *cantonensis* is closest to *T.* (*T.*) *hopiensis* Alexander (northeastern China), differing especially in the coloration of the antennæ, legs, and wings, and in the details of venation.

TIPULA (VESTIPLEX) INQUINATA sp. nov. Plate 1, fig. 4; Plate 2, fig. 29.

General coloration yellowish gray, præscutum with three brown stripes, median stripe divided by a paler central vitta; antennæ short, scape and pedicel yellow, flagellum black; legs black, femoral bases yellow; wings dark brown, patterned with yellow, beyond cord the latter including only an incomplete fascia distad of stigma and anterior cord; basal abdominal segments reddish brown, outer segments black; male hypopygium with ninth tergite divided medially, blackened sublateral lobes large; basistyle unarmed.

Male.—Length, about 12 millimeters; wing, 15; antenna, about 2.5.

Frontal prolongation of head black, pruinose; nasus short and obtuse; basal segment of palpus obscure yellow, outer segments black. Antennæ short, as shown by measurements, if bent backward not reaching wing root; scape and pedicel light yellow, flagellum black; first flagellar segment unusually long, about equal in length to combined scape and pedicel, cylindrical; succeeding segments short, gradually decreasing in length, basal enlargement feebly indicated; terminal segment oval, about one-third penultimate; longest verticils subequal in length to segments. Head yellowish gray, center of vertex more darkened.

Mesonotal præscutum yellowish gray, with three brown stripes, median stripe divided by a paler central vitta, stripes not bordered by darker; scutum yellowish gray, each lobe with two darker brown areas; posterior sclerites of notum dark, pruinose. Pleura gray. Halteres dark brown, base of stem narrowly yellow. Legs with coxæ gray; trochanters yellow; femora black, bases broadly yellow, narrowest on forelegs; tibiæ and tarsi black; claws with short basal spur. Wings (Plate 1, fig. 4) dark brown, handsomely patterned with yellow; prearcular field and cell Sc light yellow, cell C darker except at outer end; darker brown areas in bases of cells R and M and at stigma; pale yellow areas over surface, beyond cord and stigma appearing as a short band extending from C to R_{4+5}, with a vague brightening in base of cell R_5; basad of cord yellow areas more extensive, subequal in area to ground color, including two marginal areas in each of cells 1st A and 2d A; conspicuous,

more whitened obliterative areas before stigma and across cell 1st M_2 from cell R into base of cell M_3; veins brown, paler in yellow areas. Venation: Rs exceeding twice length of m-cu; petiole of cell M_1 a little longer than m.

Basal abdominal segments reddish brown, basal tergite more pruinose, lateral margins of succeeding tergites gray, segments variegated with darker; fifth and succeeding segments, including hypopygium, more uniformly blackened. Male hypopygium of general type of *divisotergata.* Ninth tergite divided medially, blackened sublateral lobes much larger than in latter species, margins microscopically roughened. Basistyle unarmed. Outer dististyle flattened. Inner dististyle (Plate 2, fig. 29, *id*) ; posterior margin with a low darkened setiferous tubercle; a long dorsal crest.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, altitude 10,000 feet, June 10, 1937 (*Tsen*).

The nearest ally is *Tipula* (*Vestiplex*) *divisotergata* Alexander, which has the general plan of structure of the male hypopygium somewhat similar but with the details entirely distinct, and with the coloration of the body and wings different.

TIPULA (VESTIPLEX) SUBTESTATA sp. nov. Plate 1, fig. 5; Plate 2, fig. 30.

General coloration of thorax yellow, præscutum with four reddish brown stripes; antennæ (male) elongate, exceeding one-half length of body, scape and pedicel yellow, flagellum black; legs black, femoral bases paler; wings pale brown, variegated by whitish subhyaline areas; prearcular field light yellow, cell Sc dark brown; several macrotrichia in outer ends of cells R_3 to M_1, inclusive; basal abdominal tergites yellow, narrowly trilineate with black, outer segments uniformly blackened; male hypopygium with basistyle produced into a strong black spine; tergite with caudal margin deeply emarginate, blackened, crenulate; ventral surface of tergite with two lobes that are black and tufted with setæ at tips.

Male.—Length, about 12 to 12.5 millimeters; wing, 15 to 16; antenna, about 8 to 8.5.

Frontal prolongation of head yellow; nasus distinct; basal segment of palpus obscure yellow, other segments dark brown. Antennæ (male) unusually long, if bent backward extending nearly to base of fifth abdominal segment; scape, pedicel, and basal half of first flagellar segment yellow, remainder black; basal enlargement of flagellar segments feeble, outer portion cylindrical; ver-

ticils a little more than one-half segments; terminal segment greatly reduced. Head fulvous-yellow; vertical tubercle low, simple.

Thorax yellow pollinose, præscutum with four darker reddish brown stripes, intermediate pair narrowly separated by a pale vitta that is scarcely indicated in front; scutal lobes weakly infuscated. Halteres dark brown, stem more yellow, especially at base and along lower face. Legs with coxæ and trochanters yellow; femora obscure yellow at base, soon passing into brown, tips blackened; remainder of legs black; claws small, simple. Wings (Plate 1, fig. 5) with ground color pale brown, variegated by whitish subhyaline areas; prearcular field abruptly light yellow; cell C light brown, stigma medium brown, cell Sc dark brown; whitish areas most extensive before cord, especially in basal cells, beyond cord appearing as an incomplete band beyond stigma and as restricted obliterative areas across cell 1st M_2; veins dark brown, brightened in prearcular field. Squama naked; rather numerous macrotrichia in outer ends of cells R_3, R_5, and M_1 (indicated in figure by stippling). Venation: R_{2+3} relatively long, subequal to m-cu, latter about one-half Rs; R_{1+2} entire; cell M_1 a little longer than its petiole.

Basal three abdominal tergites yellow, narrowly trilineate with black, fourth segment more yellowish brown; outer segments uniformly black; basal four sternites uniformly yellow, outer segments more obscure. Male hypopygium (Plate 2, fig. 30) with tergite, *9t*, and sternite, *9s*, separate; basistyle, *b*, entire, caudal margin produced into a strong, gently curved, black spine, tip acute. Ninth tergite, *9t*, narrowly divided medially, caudal margin with a conspicuous V-shaped median notch, margin blackened, microscopically roughened, prolonged outwardly into blackened lobes; ventral face of tergite with conspicuous, hairy-tipped lobes, the longer outer pair directed caudad and mesad (in slide mounts swinging to a lateral position, as figured), the shorter posterior lobes directed mesad. Dististyles as figured; outer dististyle, *od*, clavate, darkened; inner style, *id*, compressed, with a flattened beak, apex obtuse; dorsal crest very narrow, blackened.

Habitat.—China (Szechwan).

Holotype, male Mount Omei, Chu Lao Tong Temple, altitude 6,500 feet, June 5 and 6, 1937 (*Tsen*). Paratopotype, male.

Tipula (*Vestiplex*) *subtestata* is closest to *T.* (*V.*) *testata* Alexander, likewise from Szechwan, which agrees in the general

coloration and elongate antennæ of the male, differing conspicuously in the lack of macrotrichia of the wing cells and the very differently constructed male hypopygium.

TIPULA (OREOMYZA) INTERRITA sp. nov. Plate 1, fig. 6; Plate 2, fig. 31.

Large (wing, male, over 25 millimeters); general coloration gray, præscutum with four dark-gray stripes, interspaces and humeral region velvety black; antennæ relatively short, black; halteres with knobs brownish black; legs black, femoral bases yellow, tibiæ brown basally, passing into black; wings yellowish brown, prearcular region and cell Sc yellow; two major cream-colored areas on disc, one in outer portion of cell M, other more basal in cells Cu and 1st A; stigma darker than ground; abdomen blackened, pruinose; male hypopygium with caudal margin of tergite four-lobed; basistyle produced into a flattened truncate blade; inner dististyle very complex; eighth sternite produced caudad into a broad shovel-shaped median lobe, apex truncated or very weakly emarginate.

Male.—Length, about 23 millimeters; wing 25.5; antenna, about 4.5.

Frontal prolongation of head relatively long, nearly as long as remainder of head, dark gray throughout; nasus distinct; palpi black. Antennæ relatively short, black, scape pruinose, pedicel more brownish at apex; flagellar segments with basal swellings moderately developed; longest verticils a trifle exceeding segments. Head gray, lighter gray on anterior vertex; a narrow, dark-brown, median vitta, slightly widened behind.

Pronotum gray, with conspicuous black setigerous punctures. Mesonotal præscutum with four dark-gray stripes that are narrowly bordered by darker; ground color light gray, very restricted by intense velvety black areas that occupy posterior interspaces, curving laterad around cephalic ends of lateral stripes; outer humeral region similarly intense velvety black, lateral borders of præscutum more brownish black; median area of scutum light gray, with a few black setigerous punctures, outer portions of lobes dark gray, bordered in front by velvety black, suture similarly blackened; scutellum gray, with a brown median vitta; postnotum gray. Pleura gray, dorsopleural region buffy, bordered beneath on anepisternum by more dusky. Halteres elongate, stem obscure yellow, knob brownish black. Legs with coxæ and trochanters gray; remainder of legs long, especially tarsi; femora black, bases narrowly but conspicuously light yellow, amount subequal on all legs; tibiæ brown basally,

passing into black; tarsi black; claws small, simple. Wings (Plate 1, fig. 6) yellowish brown, prearcular region and cell Sc yellow; stigma medium brown; paler brown clouds at origin of Rs and on anterior cord; whitish obliterative areas before stigma and across cell 1st M_2; two major cream-colored areas, one at about two-thirds length of cell M, other in subbasal portions of cells Cu and 1st A; a less distinct pale area over Rs; cells beyond cord uniformly darkened; veins brown, more yellowish in brightened areas. Macrotrichia of veins beyond cord sparse; squama naked. Venation: Rs about one and one-third to one and one-half as long as m-cu; petiole of cell M_1 short; cell 1st M_2 elongate.

Abdomen blackened, dark gray pruinose; hypopygium dark, styli and other appendages paling to yellow. Male hypopygium (Plate 2, fig. 31) with tergite, *9t*, entirely separated from sternite, *9s*. Ninth tergite, *9t*, with caudal border broadly yellow, apical margin four-lobed; outer lobes divergent, directed caudad and slightly ventrad, slender, subglabrous; inner lobes shorter, more triangular in outline, separated by a V-shaped notch, directed caudad. Basistyle, *b*, entire, caudal margin produced into a broad flattened lobe, apex truncated, surface with long coarse setæ. Outer dististyle flattened. Inner dististyle, *id*, very complex; on its posterior border and apparently arising from ventromesal face of basistyle a conspicuous pale lobe, stem slender, apex expanded into an irregular head. Ninth sternite, *9s*, with a narrow line of pale membrane on midline beneath. Eighth sternite, *8s*, slightly projecting in a broad lobe, apex truncated or very weakly emarginate.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, White Cloud Temple, altitude 9,000 feet, June 12, 1937 (*Tsen*).

There is no species known to me with which the present striking fly may be profitably compared.

TIPULA (OREOMYZA) PERLATA sp. nov. Plate 1, fig. 7; Plate 2, fig. 32.

General coloration gray, præscutum with four scarcely differentiated plumbeous-gray stripes; antennæ (male) moderately long, if bent backward extending to shortly beyond base of abdomen; legs black, femoral bases yellow; wings broad, yellowish brown, cells C and Sc uniformly dark brown; R_{1+2} atrophied; male hypopygium with tergite notched medially; caudal border of eighth sternite with a pale median incision, on either side with a lobe bearing decussate setæ.

Male.—Length, about 13 to 14 millimeters; wing, 13 to 15; antennæ, about 4 to 4.5.

Female.—Length, about 15 millimeters; wings, 16.

Frontal prolongation of head black, more or less pruinose; nasus distinct; palpi black. Antennæ (male) moderately long, if bent backward extending to shortly beyond base of abdomen; black, pedicel a little paler; flagellar segments moderately incised; verticils subequal in length to segments; thirteenth segment reduced to a mere button. Head gray; vertical tubercle low.

Mesonotum dark gray, præscutum with four scarcely differentiated, plumbeous-gray stripes. Pleura light gray; dorsopleural membrane dark. Halteres relatively long, obscure yellow, knobs weakly darkened. Legs with coxæ light gray; trochanters obscure yellow; remainder of legs black, femoral bases obscure yellow, on forelegs involving about proximal fourth, on posterior legs about proximal half; tibial spur formula 1 : 2 : 2; claws (male) simple. Wings (Plate 1, fig. 7) broad, almost uniformly tinged with yellowish brown, cells C and Sc beyond arculus dark brown; stigma pale, scarcely differentiated from ground; very restricted obliterative areas on membrane before stigma and on either side of cord in cells R and 1st M_2, adjoining veins much more extensively obliterated; veins dark. Squama naked; abundant macrotrichia on all longitudinal veins beyond cord. Venation: R_{1+2} entirely atrophied or represented by a tiny spur only; Rs about one and one-third to one and one-half as long as oblique m-cu; cell 1st M_2 variable in shape; petiole of cell M_1 varying from much shorter than m to longer than this element; cell 2d A relatively narrow.

Abdomen black, surface sparsely pruinose; lateral margins of outer segments grayish. Male hypopygium (Plate 2, fig. 32) relatively small, tergite, *9t*, and sternite, *9s*, separated. Ninth tergite, *9t*, with a narrow median notch, lateral lobes subcontiguous, obtuse, their margins microscopically crenulate. Outer dististyle, *od*, unusually small, cylindrical, with sparse long setæ. Inner dististyle, *id*, shaped as in many species of *Nephrotoma;* both apical and lateral lobes blunt, heavily blackened. Eighth sternite, *8s*, with a median notch that is filled with pale membrane, on either side with a small marginal lobe that bears long decussate setæ. Ovipositor with slender, straight cerci.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, White Cloud Temple, altitude 9,000 feet, June 12, 1937 (*Tsen*). Allotopotype, female. Para-

topotypes, 8 males, altitude 9,000 to 11,000 feet, June 9 to 12, 1937 (*Tsen*).

Tipula (*Oreomyza*) *perlata* is readily told from other regional species by the broad, strongly tinted wings, with the costal border narrowly but conspicuously dark brown.

TIPULA (OREOMYZA) LÆTISSIMA sp. nov. Plate 1, fig. 8; Plate 3, fig. 33.

General coloration gray, præscutum with four darker gray stripes, intermediate pair separated by a capillary dark-brown median vitta; antennal flagellum beyond basal segment black; pleura light gray; knobs of halteres dark brown; legs black, femoral bases broadly yellow; wings brown, variegated with darker brown and whitish hyaline, latter including a complete crossband beyond cord; prearcular region and base of costal field beyond h bright yellow; a major dark marking beyond arculus and surrounding h; R_{1+2} entire; outer abdominal segments blackened; male hypopygium with caudal border of tergite with a U-shaped notch, lateral lobes truncate; basistyle not produced; inner dististyle with a conspicuous fleshy lobe on outer margin at base.

Male.—Length, about 15 millimeters; wing, 16.5; antennæ, about 5.

Female.—Length, about 20 to 22 millimeters; wing, 18 to 19.

Frontal prolongation of head relatively long, dark gray; nasus short but distinct; palpi black. Antennæ (male) moderately long; basal three segments brown, first more or less pruinose; succeeding segments black, moderately incised, longest verticils a trifle longer than segments; in female, antennæ shorter, incisures slightly pale. Head dark gray, sides of posterior vertex and a vague median line slightly darkened; vertical tubercle of moderate size.

Mesonotum light gray, with four darker gray stripes, intermediate pair separated by a capillary dark-brown median vitta that becomes obsolete behind; setigerous punctures of humeral region conspicuous, dark brown, of posterior interspaces much less distinct; scutum gray, lobes variegated with brown; scutellum and postnotum much darker gray. Pleura light gray, dorsopleural membrane more buffy. Halteres yellow, knobs dark brown. Legs with coxæ light gray; trochanters obscure yellow; femora black, bases broadly yellow, involving approximately basal third of segment; tibiæ and tarsi black; claws (male) with a basal spine. Wings (Plate 1, fig. 8) with ground color brown, variegated by darker brown and whitish hyaline areas

to produce an unusually brillant pattern; entire prearcular field, as well as cell Sc, and cell C beyond basal portion, brilliant yellow; darker brown areas including a postarcular darkening in bases of cells R and M, with a slightly disconnected area in cell C on either side of h which is scarcely visible against this ground; stigma and a confluent area on anterior cord, as well as outer portion of cell C dark brown; whitish areas include a complete band beyond cord from base of cell R_2 to posterior margin in cell M_3; major white areas before cord include three in cell R, two in cell M, three in cell Cu, the extensive outer area crossing vein 1st A into the outer end of cell 1st A, the more basal two areas invading cell 1st A behind; an isolated marginal area in cell 1st A and base of cell 2d A; a much less distinct brightening near outer end of cell R_5; veins brown, yellow in flavous areas. Venation: R_{1+2} short but complete, oblique in position; Rs elongate, exceeding twice m-cu; petiole of cell M_1 subequal to or shorter than m.

Basal abdominal tergite gray; succeeding three tergites yellow, restrictedly darkened laterally, with a broken median vitta that is broadly interrupted at proximal end of each segment; segments beyond fifth uniformly blackened. Male hypopygium (Plate 3, fig. 33) relatively large, compressed; ninth sternite, *9s*, separate from tergite, *9t;* basistyle, *b*, entire, not produced. Ninth tergite, *9t*, extensive, flattened, caudal margin with a U-shaped median notch, lateral lobes broad, with truncated apices; dorsal surface with numerous scattered setæ, lacking on median area which is very little produced at base of median notch. Outer dististyle a little expanded at base, outer portion subcylindrical, gently curved. Inner dististyle, *id*, with an extensive lobe on posterior margin at base, lower portion of lobe covered with abundant delicate setulæ. Eighth sternite unarmed, without lobes or setal brushes.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, White Cloud Temple, altitude 9,000 feet, June 12, 1937 (*Tsen*). Allotopotype, female, summit, altitude 11,000 feet, June 8, 1937. Paratopotype, female, with the allotype.

This singularly beautiful fly is allied to *Tipula* (*Oreomyza*) *lætibasis* Alexander and similar species, differing conspicuously in the coloration of the body, the wing pattern, and the structure of the male hypopygium. The wings, with the prearcular field yellow, followed by a major dark-brown area, and with a complete white fascia beyond the cord, are distinctive.

TIPULA (OREOMYZA) SEXLOBATA sp. nov. Plate 1, fig. 9; Plate 3, fig. 34.

General coloration gray, præscutum with four darker brownish gray stripes; antennal scape and pedicel yellow, flagellum black, segments weakly incised; legs black, only femoral bases restrictedly yellow; claws (male) toothed; wings almost uniformly brown, sparsely variegated with cream-colored areas; basal abdominal segments chiefly reddish yellow, outer segments black; male hypopygium with tergite bearing six lobes, two pairs on ventral surface bearing conspicuous tufts of setæ; inner dististyle with a slender yellow horn on outer margin at base; eighth sternite unarmed.

Male.—Length, about 16 millimeters; wing, 20; antennæ, about 5.

Frontal prolongation of head buffy yellow above, more infuscated on sides; nasus long, pale yellow; palpi brownish black, incisures a little paler. Antennæ with scape and pedicel yellow, flagellum black; flagellar segments only weakly incised; longest verticils subequal in length to segments; terminal segment a tiny oval button. Head gray, more ochreous on sides of anterior vertex; a capillary dusky median vitta.

Pronotum yellowish gray, with a dusky median line, and more or less darkened on sides. Mesonotal præscutum light gray, with four slightly darker brownish gray stripes, intermediate pair confluent and dusky at extreme cephalic ends; lateral stripes a little darker than intermediates; posterior sclerites of notum light gray, each lobe variegated by brownish gray areas. Pleura gray, dorsopleural membrane buffy yellow. Halteres yellow, knob dark brown, its apex a trifle paler. Legs with coxæ light gray; trochanters yellow; remainder of legs black, only femoral bases narrowly yellow; claws (male) with a single basal spine. Wings (Plate 1, fig. 9) almost uniformly brown, sparsely variegated by whitish subhyaline or creamy areas; prearcular field and cells C and Sc light yellow, outer end of cell C slightly more darkened; stigma and a confluent cloud on anterior cord darker brown; pale obliterative areas before stigma and across cell 1st M_2; creamy areas in extreme base of cell R_3, near base and outer end of cells M and Cu, and near bases of both anal cells; a small pale marginal spot in cell 1st A; veins dark brown. No squamal setæ. Venation: R_{1+2} longer than R_{2+3}; Rs very long, about two and one-half times m-cu; M_{3+4} a little shorter than basal section of M_3.

Abdomen with basal four segments reddish yellow, narrowly striped with darker; outer segments, including hypopygium,

black. Male hypopygium (Plate 3, fig. 34) with tergites, *9t*, narrowed outwardly, caudal margin with a deep U-shaped to nearly rectangular median notch, lateral lobes obliquely truncate, terminating in slender lateral points; oblique margins of these lobes microscopically crenulate; on ventral surface of tergite on either side with two further lobes, both conspicuously tufted with setæ, more cephalic lobe shorter and stouter; normal surface setæ of tergite virtually lacking. Basistyle with caudal margin bearing a small obtuse glabrous lobe, apical border produced into a short blackened spine. Outer dististyle, *od*, dusky, weakly spatulate. Inner dististyle, *id*, stout; apical beak stout; posterior portion at base produced into a slender yellow horn that bears numerous setæ. Eighth sternite unarmed. Ædeagus, *a*, triangular, short, subtending apophyses greatly reduced to virtually lacking.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, summit, altitude 11,000 feet, June 9, 1937 (*Tsen*).

Tipula (*Oreomyza*) *sexlobata* is quite different from other allied forms of generally similar coloration, the chief distinctions being found in the tergite and styli of the male hypopygium.

TIPULA (OREOMYZA) COMPRESSILOBA sp. nov. Plate 1, fig. 10; Plate 3, fig. 35.

General coloration gray, præscutum with three conspicuous dark-gray stripes; antennal scape and pedicel yellow, flagellum black; halteres brownish black, base of stem restrictedly obscure yellow; legs black, femoral bases narrowly obscure yellow; wings yellowish brown to pale brown, sparsely variegated with whitish and cream-colored areas; cell 1st M_2 with inner end pointed; basal abdominal segments reddish yellow, striped with black; outer segments uniformly black; male hypopygium with tergite broadly notched medially, from ventral surface on either side with a compressed blade.

Male.—Length, about 13 to 14 millimeters; wing, 17 to 18.5; antennæ, about 5.5 to 6.

Female.—Length, about 16 millimeters; wing, 14.

Frontal prolongation of head brown to yellowish brown; nasus distinct; palpi black. Antennæ (male) relatively long; scape and pedicel yellow, flagellum black; flagellar segments moderately incised, relatively long, verticils shorter than segments; terminal segment reduced. Head gray, vertex with a dusky median line; vertical tubercle low, entire.

Pronotum gray, darkened medially. Mesonotal præscutum gray, with three conspicuous dark-gray or brownish-gray stripes, median stripe very insensibly divided medially by double dusky lines; posterior sclerites of notum gray, scutal lobes conspicuously variegated by brownish gray; a vague capillary median darkening on postnotum. Pleura light gray; dorsopleural membrane obscure yellow. Halteres brownish black, base of stem restrictedly obscure yellow. Legs with coxæ light gray; trochanters obscure yellow; remainder of legs black, femoral bases very narrowly obscure yellow. Wings (Plate 1, fig. 10) with a strong yellowish-brown to pale-brown tinge, cell Sc somewhat clearer yellow; stigma and a confluent cloud on anterior cord slightly darker brown; restricted whitish obliterative areas before stigma and across cell 1st M_2; in cases ground color variegated by very restricted cream-colored areas in base and apex of cell M and in cells Cu, 1st A, and 2d A; in still other cases these areas quite lacking; veins dark brown. Venation: Rs long, from two to two and one-half times as long as m-cu; cell 1st M_2 narrow, its inner end pointed; cell M_1 deep, its petiole subequal to or shorter than m.

Basal abdominal tergites gray; tergites two to four reddish yellow, with a very broad entire black dorsal stripe and less distinct sublateral stripes, most conspicuous on second segment, lateral borders gray; fifth and succeeding segments uniformly black; basal sternites uniformly yellow. Male hypopygium (Plate 3, fig. 35) with tergite, *9t*, sternite, *9s*, and basistyle, *b*, separate. Ninth tergite, *9t*, with caudal border broadly notched, margin microscopically roughened; from ventral surface on either side a compressed blade projecting caudad, apex obtuse, ventral margin microscopically roughened. Basistyle, *b*, unarmed. Outer dististyle, *od*, relatively small, dusky, weakly spatulate. Inner dististyle, *id*, as figured. Ædeagus, *a*, projecting caudad from the genital chamber, dorsal surface channelled, tip decurved.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, summit, altitude 11,000 feet, June 9, 1937 (*Tsen*). Allotopotype, female. Paratopotypes, 7 specimens, males and females, altitude 9,000 to 11,000 feet, June 12 to 14, 1937 (*Tsen*).

In its general appearance *Tipula* (*Oreomyza*) *compressiloba* is very similar to *T.* (*O.*) *sexlobata* sp. nov., but the structure of the male hypopygium indicates a very distinct species.

TIPULA (OREOMYZA) PERCOMMODA sp. nov. Plate 1, fig. 11; Plate 3, fig. 36.

General coloration light gray, præscutum with four darker stripes; antennæ (male) relatively long, if bent backward extending about to base of abdomen; scape and pedicel obscure yellow, flagellum black; flagellar segments with basal enlargement only feebly developed; apex of knob of halteres yellow; legs black, femoral bases narrowly yellow; claws (male) simple; wings beautifully variegated light yellow and brown, including numerous yellow areas before cord and an incomplete crossband beyond cord; cell M_1 short-petiolate; basal abdominal segments yellow, striped with black; sixth and succeeding segments uniformly black; male hypopygium with tergite notched, ventral surface on either side with a compressed triangular blade; basistyle at apex produced into a glabrous blade; outer dististyle long and slender, nearly cylindrical; inner dististyle large, scoop-shaped.

Male.—Length, about 16 millimeters; wing, 18; antennæ, about 6.5.

Frontal prolongation of head moderately long, gray; nasus distinct; palpi black. Antennæ (male) relatively long, if bent backward extending approximately to base of abdomen; scape and pedicel obscure yellow, flagellum black, first segment a trifle brightened at base; flagellar segments subcylindrical, with feebly indicated basal swellings; longest verticils subequal to or shorter than segments; terminal segment greatly reduced. Head gray, more yellowish on front and orbits; a dusky median vitta on posterior vertex; vertical tubercle entire.

Pronotum brownish gray. Mesonotal præscutum light gray with four darker stripes, intermediate pair darker gray, narrowly bordered by more brownish gray, including a median vitta; lateral stripes slightly darker brownish gray; scutum light gray with large brownish-gray areas on lobes; scutellum and mediotergite light gray, with a conspicuous dark median line. Pleura light gray; dorsopleural membrane more buffy. Halteres with stem obscure yellow, base of knob dark brown, tip abruptly and conspicuously pale yellow. Legs with coxæ light gray; trochanters obscure yellow; remainder of legs black, femoral bases narrowly yellow; claws (male) simple. Wings (Plate 1, fig. 11) beautifully variegated light yellow and brown, prearcular region and cell Sc brighter yellow; ground color brown, including cell C; whitish obliterative areas before stigma, with a major area crossing cell 1st M_2; yellow areas in all cells

before cord, subequal in extent to dark ground, bases of cells R and M of latter color; a broad incomplete crossband beyond cord, extending from costa to cell 1st M_2; veins brown, more brightened in yellow areas. Squama naked. Venation: Rs about twice m-cu; R_{1+2} entire; cell M_1 very short-petiolate to nearly sessile; M_{3+4} shorter than basal section of M_3.

Basal abdominal tergite gray pruinose, tergites two to five yellow, with a continuous black median stripe and less distinct sublateral stripes, extreme margins more grayish; basal sternites more uniformly yellow; outer segments uniformly black. Male hypopygium (Plate 3, fig. 36) with tergite, *9t*, separated from sternite, *9s*, except on cephalic third; basistyle entire. Ninth tergite, *9t*, transverse, narrowly divided medially by pale membrane; caudal margin with a V-shaped median notch, lateral lobes low and obtuse; from ventral surface of tergite on either side a compressed triangular blade, directed caudad. Basistyle, *b*, produced apically into a conspicuous, long-triangular, glabrous blade, tip narrowly obtuse. Outer dististyle, *od*, long and slender, nearly cylindrical. Inner dististyle, *id*, large and massive, shallowly scoop-shaped; a long dorsal crest with long sparse setæ. Eighth sternite simple. Ædeagus small, decurved; gonapophyses greatly reduced.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, between White Cloud Temple and summit, altitude 10,000 feet, June 10, 1937 (*Tsen*).

Tipula (*Oreomyza*) *percommoda* is apparently most nearly allied to *T.* (*O.*) *compressiloba* sp. nov. and similar species, differing in the conspicuously patterned wings and in the structure of the male hypopygium.

TIPULA (OREOMYZA) PROCLIVA sp. nov. Plate 1, fig. 12; Plate 3, fig. 37.

General coloration gray, præscutum with four slightly differentiated, clearer gray stripes; antennæ black, basal three segments yellow; legs brownish black, femoral bases broadly yellow; wings brown, prearcular field conspicuously bright yellow; three large white discal areas, including a virtually complete band beyond cord; basal abdominal segments yellow, tergites trivittate with brown, outer segments uniformly black; male hypopygium with tergite notched medially, incision bearing a conspicuous median spine; basistyle produced into a spine; outer dististyle compressed.

Male.—Length, about 14 to 15 millimeters; wing 16.5 to 17.5; antennæ, about 4 to 4.2.

Female.—Length, about 22 millimeters; wing, 19.

Frontal prolongation of head obscure yellow above, darker laterally, pruinose at base; nasus distinct; palpi black. Antennæ (male) relatively short, if bent backward extending about to wing root; scape and pedicel light yellow; first flagellar segment yellow, apex darkened, remainder of flagellum black; flagellar segments moderately incised; longest verticils subequal to segments; terminal (thirteenth) segment variable in size, from one-third penultimate to greatly reduced. Head gray, center of vertex darker; vertical tubercle low and indistinct.

Mesonotum brownish gray, præscutum with four slightly differentiated, clearer gray stripes that are insensibly bordered by darker, intermediate stripes nearly confluent at anterior and posterior ends, more widely separated in intermediate portion; each scutal lobe with two dark areas. Pleura yellowish gray, variegated with darker gray areas; dorsopleural membrane yellow. Halteres brownish yellow, knobs dark brown. Legs with coxæ yellowish gray; trochanters obscure yellow; femora dark brown, passing into black at tips, bases broadly yellowish, narrowest (about basal fourth) on forelegs, widest (about basal two-thirds to three-fourths) on posterior femora; tibiæ brownish black, tips black; tarsi black; tibial spur formula 1:2:2; claws (male) with a single erect spine on basal half. Wings (Plate 1, fig. 12) with ground color brown, prearcular field conspicuously bright yellow; wing disc with three conspicuous whitish areas, including a nearly complete band beyond cord, from costal border in cell R_2 to midlength of cell M_4 or beyond practically to posterior border; second area at near two-thirds length of cell M, more or less invading cell R in front, very extensively so in female; third area more basal, involving subbasal portions of cells Cu and 1st A; stigma, cells Sc and Cu_1, and a seam on anterior cord darker than ground; veins brown, yellow in flavous areas, especially prearcular field. Venation: Distal end of vein R_{1+2} atrophied, spur varying in completeness from one-half to three-fourths length; petiole of cell M_1 subequal to or slightly longer than m.

Abdomen with basal four tergites yellow, trivittate with brown, median vitta very narrow on first tergite and basal half of second, widened behind; first tergite opaque, succeeding segments and basal sternites polished yellow; outer segments, including hypopygium, black. Male hypopygium (Plate 3, fig. 37) relatively large, compressed; tergite and sternite separated. Ninth

tergite, *9t*, extensive, slightly narrowed outwardly, caudal margin with a broad U-shaped notch, median region further produced into a long spine; lateral lobes obtuse, obliquely truncated. Basistyle, *b*, entire, caudal margin produced into a strong straight spine. Outer dististyle, *od*, compressed, widened outwardly, apex obliquely truncated. Inner dististyle, *id*, shaped as in figure; outer margin at midlength produced into a spine; at base prolonged into a more flattened scoop. Eighth sternite unarmed.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, Chu Lao Tong Temple, altitude 6,500 feet, June 6, 1937 (*Tsen*). Allotopotype, female, June 5 and 6, 1937. Paratopotype, male, June 5, 1937.

Tipula (*Oreomyza*) *procliva* is entirely different from all other regional species of the subgenus having the basistyle of the male hypopygium produced into a spine.

TIPULA (OREOMYZA) PERTENUIS sp. nov. Plate 1, fig. 13; Plate 3, fig. 38.

Belongs to the *mutila* group; general coloration gray, præscutum with four slightly darker gray stripes, intermediate pair separated by a capillary brown vitta; antennæ with basal three segments yellow, remaining segment black; halteres yellow; legs black, femoral bases restrictedly yellow: claws (male) with a small basal tooth; wings with ground color rich brown, arcular region and cell Sc light yellow; disc of wing with large cream-colored areas, including an incomplete stripe beyond cord; m-cu and M_{3+4} subequal, basal abdominal segments yellow with an entire median black stripe; outer segments uniformly blackened; male hypopygium with basistyle produced caudad into a slender hairy lobe; outer dististyle flattened; inner dististyle narrow; gonapophyses paired, scabrous at tips; eighth sternite truncated at tip, with dense short setæ.

Male.—Length, about 11 to 11.5 millimeters; wing, 12 to 12.5; antennæ, about 4.

Frontal prolongation of head obscure yellow to brownish yellow above, including long slender nasus; lower surface blackened; palpi black. Antennæ moderately long; basal three segments yellow, remainder black; flagellar segments weakly incised; longest verticils a little shorter than segments; terminal segment reduced, about one-third penultimate, narrowed outwardly. Head gray, posterior vertex with a capillary dark vitta.

Pronotum gray. Mesonotal præscutum light gray, with four darker gray stripes, intermediate pair separated by a capillary brown median vitta, their outer margins narrowly bordered by brownish gray; lateral stripes poorly defined, best indicated along their lateral borders; setigerous punctures small and relatively inconspicuous; posterior sclerites of notum light gray, scutal lobes and central areas of scutum, scutellum, and mediotergite darker. Pleura gray, dorsopleural membrane buffy yellow. Halteres yellow, knob not or scarcely darkened. Legs with coxæ gray, posterior pair paler; remainder of legs black, femoral bases restrictedly yellow; claws (male) with a small basal tooth. Wings (Plate 1, fig. 13) with ground color rich brown, arcular region and cell Sc clear light yellow; stigma slightly darker brown; cream-colored areas on disc, including a narrow and more or less broken band beyond stigma in cells R_2, R_3, and R_5; an area across cell 1st M_2 and large spots before cord, including an ill-delimited area near bases of cells R and M, with other areas in outer ends of these cells and in cells Cu and 1st A; outer wing cells and 1st A uniformly darkened; veins brown, yellow in flavous areas. Venation: R_{1+2} entirely atrophied; R_2 meeting $Sc_2 + R_1$ at an angle; Rs long, approximately three times m-cu, the latter subequal to the long M_{3+4}; petiole of cell M_1 longer than m.

Abdominal tergites with basal three or four segments yellow, with a broad blackish median stripe that is widened behind; outer segments, including hypopygium, blackened; in some specimens, including the type, the pale color does not extend beyond the second tergite; basal sternites brightened. Male hypopygium (Plate 3, fig. 38) relatively large and conspicuous, tergite, *9t*, and sternite entirely separate; basistyle, *b*, entire, caudal margin produced caudad into a slender lobe, more flattened on one face than on the other, with numerous long setæ and delicate scattered setulæ. Ninth tergite, *9t*, narrowed posteriorly, restrictedly divided medially by pale membrane, each side slightly bilobed, lobes obtuse, one smaller and glabrous. Outer dististyle, *od*, flattened, broadest on basal half. Inner dististyle, *id*, unusually narrow, apex slender, subacute, surface with longitudinal striæ; surface and margin with scattered setæ; from posterior outer angle juts a conspicuous pale lobe. Gonapophyses, *g*, paired, jutting from genital chamber, apex of each obliquely truncated, microscopically roughened and scabrous.

Eight sternite, 8*s*, moderately projecting, narrowed posteriorly, apex broadly truncated; setæ at apex longer and more abundant than elsewhere on sclerite.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, White Cloud Temple, altitude 9,000 feet, June 12, 1937 (*Tsen*). Paratopotypes, 2 males.

Tipula (*Oreomyza*) *pertenuis* is closest to *T.* (*O.*) *mutiloides* Alexander and *T.* (*O.*) *submutila* Alexander among the described regional forms, differing conspicuously in the pattern of the wings and, especially, in the structure of the male hypopygium, notably the produced basistyles and paired scabrous gonapophyses.

DOLICHOPEZA (DOLICHOPEZA) HONSHIUENSIS sp. nov. Plate 1, fig. 14; Plate 4, fig. 39.

Mesonotal præscutum and scutal lobes uniformly blackened; antennæ (male) relatively long, scape and pedicel yellow, flagellum black; pleura slightly variegated with darker; femora yellow, tips broadly blackened; tibiæ black; basitarsi black, tips narrowly snowy white; remaining tarsal segments chiefly white; wings weakly tinged with brown; stigma oval, darker brown; Sc_2 ending a short distance beyond origin of short oblique Rs; medial forks shallow; outer abdominal segments blackened; male hypopygium with tergite trilobed; phallosome conspicuous, consisting of paired yellow spiniform blades that subtend the slightly longer ædeagus.

Male.—Length, about 12 millimeters; wing, 13; antennæ about 6.

Frontal prolongation of head short, brownish black; palpi black. Antennæ (male) relatively long, as shown by measurements; scape and pedicel yellow, flagellum black; flagellar segments subcylindrical; verticils shorter than segments; terminal segment about two-thirds penultimate. Head dull brownish black, front and anterior vertex obscure yellow.

Pronotum infuscated, obscure yellow behind. Mesonotal præscutum and scutal lobes uniformly blackened, surface nitidous, humeral region very restrictedly obscure yellow; setæ of præscutal interspaces white, of moderate length, suberect; median region of scutum and scutellum testaceous yellow, parascutella darker; central portion of mediotergite pale, posterior and lateral margins broadly blackened. Pleura yellow, variegated with brownish black on ventral anepisternum, sternopleurite, meron, and pleurotergite. Halteres elongate, stem yellow, knob

brownish black, apex slightly paler. Legs with coxæ and trochanters yellow, latter darkened on inner faces; femora obscure yellow, tips broadly blackened, more extensively so on forelegs; tibiæ black; basitarsi black basally, distal fourth or fifth white; remainder of tarsi white, terminal two segments darker. Wings (Plate 1, fig. 14) with a weak brown tinge; stigma oval, darker brown; veins brown. Macrotrichia throughout length of Rs. Venation: Sc moderately long, Sc_2 ending a short distance beyond origin of Rs, Sc_1 faintly indicated, opposite origin of Rs; Rs short, about one and one-half as long as basal section of R_{4+5}, slightly oblique; medial forks shallow; M_1 only a little longer than its petiole; cell 2d A narrower than in *katoi*.

Abdomen obscure yellow, variegated with darker, outer segments uniformly brownish black to black. Male hypopygium (Plate 4, fig. 39) with tergite, *9t*, trilobed, heavily blackened; lateral lobes relatively slender, tips truncated; median lobe lower, obtuse. Phallosome, *p*, conspicuous, consisting of paired yellow blades that subtend the longer ædeagus, these blades narrowed to acute points.

Habitat.—Japan (Honshiu).

Holotype, male, Komagatake, Yamanashi-ken, July 21, 1936 (*Jiro Machida*).

I express my deep thanks to my long-time friend, Dr. Jiro Machida, for his continued interest in sending me shipments of Japanese Tipulidæ. The nearest ally of the present fly is *Dolichopeza* (*Dolichopeza*) *katoi* Alexander (northern Honshiu, Japan), which differs conspicuously in the coloration of the body, legs, and wings, and in the structure of the male hypopygium.

CYLINDROTOMINÆ

CYLINDROTOMA MEGACERA sp. nov. Plate 1, fig. 15.

General coloration black, thorax conspicuously pitted and punctured; antennæ (male) of unusual length, about one and one-half as long as body or wing; eyes contiguous on vertex; halteres dusky, base of stem restrictedly yellow; wings with a brownish tinge; m-cu beyond midlength of cell 1st M_2; abdomen, including hypopygium, black.

Male.—Length, about 7.5 millimeters; wing, 8; antennæ, about 12.

Rostrum short, black; palpi black. Antennæ (male) about one and one-half as long as either body or wing, dark brown throughout; flagellar segments long-cylindrical, outer ten to

twelve segments all nearly equal in length, each measuring just short of 1 millimeter; verticils long, coarse, scattered over segments. Head black; eyes very large, contiguous on vertex.

Thorax dull black, surface conspicuously pitted and punctured, least so on præscutal stripes and on scutellum; dorsopleural membrane restrictedly yellow. Halteres dusky, base of stem restrictedly yellow. Legs with coxæ black; trochanters brown; femora yellow basally, darker on outer portions; tibiæ pale brown, tips narrowly dark brown; tarsi dark brown. Wings (Plate 1, fig. 15) with a brown tinge; veins darker brown. Macrotrichia on longitudinal veins beyond cord and on all but basal fifth of Rs, lacking on M, Cu, and anals. Venation: Free tip of Sc_2 persistent; basal section of R_{4+5} short; cell M_1 sessile; m-cu beyond midlength of cell 1st M_2; distal section of Cu_1 bent strongly caudad, narrowing cell Cu at margin.

Abdominal tergites, including hypopygium, black, lateral borders of segments paler; basal sternites pale, remainder dark.

Habitat.—China (Szechwan).

Holotype, male, Pehlüting (Beh-luh-din), altitude 6,000 feet, July 11, 1937 (*Franck*).

The only near relative is *Cylindrotoma taiwania* (Alexander), of Formosa and eastern China. The latter fly was described as a species of *Cyttaromyia* Scudder[4] based upon the presence of a supernumerary crossvein in cell R_5, but additional specimens received now indicate that this feature was an abnormality of the holotype specimen. I prefer to refer the two species to *Cylindrotoma,* but the marked structural characters indicate that a new genus will eventually be required for their reception. The present fly much resembles *C. taiwania* but has the antennæ unusually long, being approximately one and one-half as long as the entire body.

CYLINDROTOMA HYPOPYGIALIS sp. nov. Plate 1, fig. 16; Plate 4, fig. 40.

General coloration black; pronotum, scutellum, and cephalic portion of mediotergite light yellow; pleura chiefly yellow, variegated with black; halteres and legs black; wings strongly tinged with blackish; Sc_2 lying before level of r-m; inner end of cell 1st M_2 strongly arcuated; male hypopygium enlarged; ninth tergite strongly notched medially; ædeagus subtended on either side by about twelve acute spines.

[4] Philip. Journ. Sci. 40 (1929) 523, 524.

Male.—Length, about 11 to 13 millimeters; wing, 10 to 11; antennæ, about 4.5 to 5.

Rostrum black above, obscure yellow on sides; palpi black. Antennæ black throughout; verticils of cylindrical flagellar segments conspicuous, for the most part unilaterally distributed, Head dull black, smooth, front and posterior orbits more yellow; eyes small; anterior vertex very broad, much wider than diameter of eye as viewed from above.

Pronotum conspicuously pale yellow, restrictedly darkened laterally. Mesonotal præscutum dull black, interspaces marked by deep impressed lines, surface unsculptured; humeral region restrictedly light yellow; scutum black, median region restrictedly obscure yellow; scutellum yellow, more infuscated medially, parascutella yellow; mediotergite with cephalic third and lateral margins yellow, posterior portion broadly black. Pleura pale yellow, anepisternum and ventral sternopleurite brownish black; a smaller black area on ventral pleurotergite above root of halteres. Halteres black, extreme base of stem yellow. Legs with coxæ yellow, bases weakly infumed, especially fore and middle pairs; trochanters yellow; legs black, only femoral bases restrictedly yellow. Wings (Plate 1, fig. 16) with a strong blackish tinge, the relatively large, oval stigma still darker brown; cells C and Sc a trifle darker than remainder of ground; veins dark brown. Venation: Tip of vein Sc_1 persisting as a spur of varying lengths, Sc_2 lying just beyond fork of Rs and before level of r-m; Rs long, distinctly longer than cell 1st M_2; cell M_1 variable in length, from nearly sessile to having its petiole subequal to m; inner end of cell 1st M_2 strongly arcuated; m-cu variable in position, from about opposite one-third to nearly one-half length of cell 1st M_2.

Abdomen long, hypopygium unusually large and conspicuous; abdomen black, surface very sparsely pruinose. Male hypopygium (Plate 4, fig. 40) very conspicuous; tergite *9t*, large, strongly arched, caudal margin deeply notched medially, lateral angles produced caudad into slender lobes. Dististyle, *d*, complex, at base on inner margin with a slender curved arm. Ædeagus very complex, at apex with about a dozen acute spines on either side of ædeagus, latter narrowed and pale at tip, with microscopic points.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, summit, altitude 11,000 feet, June 9, 1937 (*Tsen*). Paratopotypes, 12 males, altitude 10,000 to 11,000 feet, June 9 and 10, 1937 (*Tsen*).

The only approximately similar species in *Cylindrotoma nigripes* Alexander,[5] from the Szechwan-Tibet border. The unique type of the latter is a badly damaged specimen that was presumed to represent the male sex, but this is uncertain, as discussed under the original account. If the specimen is a male and the antennæ are correctly associated, the species is very distinct from the present fly. In other regards, *nigripes* differs from the present fly by the uniformly darkened pronotum and mesonotum and the scarcely variegated thoracic pleura; the wings are only faintly darkened, with small stigma, and with Sc_2 lying some distance beyond the level of r-m. The present fly is the most conspicuous member of the genus yet discovered.

LIMONIINÆ

LIMONIINI

LIMONIA (LIMONIA) PERNIGRINA sp. nov. Plate 1, fig. 17; Plate 4, fig. 41.

General coloration black, including entire head and thorax; femora chiefly black, bases yellow, with a narrow yellow subterminal ring; tibiæ and tarsi black; wings yellow, heavily patterned with brown; Sc long, Sc_2 longer than Sc_1, ending opposite or beyond fork of Rs; R_{1+2} from two to four times as long as R_2 alone; vein R_3 at outer end deflected strongly caudad, cell R_2 wide at margin; cell 1st M_2 shorter than any of veins beyond it; m-cu at or shortly before fork of M; male hypopygium with caudal margin of tergite emarginate; gonapophyses with mesal-apical lobes very low and obtuse.

Male.—Length, about 10 millimeters; wing, 10.5 to 11.

Female.—Length, about 13 to 14 millimeters; wing, 12.

Rostrum black, paraglossæ paler; palpi black. Antennæ with scape and pedicel black; first flagellar segment restrictedly brightened at base, remainder of organ black; flagellar segments subcylindrical, verticils a little exceeding segments. Head black; anterior vertex wider than diameter of scape in female, a little narrower in male; head narrowed behind.

Thorax uniformly black, surface rather dull, without markings; præscutal setæ very sparse but elongate. Pleura sparsely pruinose; dorsopleural membrane dark. Halteres obscure yellow, base of knob more or less infuscated. Legs with coxæ blackened; trochanters brownish yellow; femora yellow basally,

[5] Philip. Journ. Sci. 44 (1931) 348, 349.

on forelegs including about proximal third; remainder of femora intensely black with a narrow yellow subterminal ring placed considerably more than its own length before apex; tibiæ and tarsi black. Wings (Plate 1, fig. 17) with ground color yellow, heavily and handsomely patterned with brown, restricted ground color appearing chiefly as narrow zigzag bands at basal fourth of wing, at level of origin of Rs and at cord, involving margin at ends of veins Cu, 1st A, and 2d A; other isolated yellow areas beyond stigma and in cells of outer medial field; prearcular and basal cells, together with cells C and Sc, more extensively yellow; veins yellow, darker in the infuscated areas. Venation: Sc long, Sc_1 ending a short distance before level of fork of Rs, the longer Sc_2 ending opposite or shortly beyond fork; R_{1+2} from two to four times R_2 alone, the distance variable; outer end of vein R_3 deflected strongly caudad, so cell R_2 is wide at margin; cell 1st M_2 relatively small, shorter than any of veins beyond it; m-cu at or shortly before fork of M.

Abdomen black, extreme borders of segments pale; hypopygium black. Male hypopygium (Plate 4, fig. 41) with caudal margin of tergite, *9t*, emarginate. Dististyle, *d*, with apical point slender, subequal in length to the more darkened base. Gonapophyses, *g*, very pale, mesal-apical lobes low and obtuse. Ædeagus, *a*, gradually narrowed outwardly, apex with two slender elongate points, lying parallel to one another; surface of ædeagus with microscopic erect tubercles.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, White Cloud Temple, altitude 9,000 feet, June 12, 1937 (*Tsen*). Allotopotype, female. Paratopotypes, 1 male, 1 female; 1 male, summit, altitude 11,000 feet, June 9, 1937 (*Tsen*).

Limonia (*Limonia*) *pernigrina* is very different from the most similar regional species, *L.* (*L.*) *nominata* Alexander and *L.* (*L.*) *prudentia* Alexander, differing especially in the uniform black color and in the pattern of the legs and wings.

LIMONIA (LIMONIA) AMABILIS ANTISTES subsp. nov.

Female.—Length, about 10 millimeters; wing, 10.

Close to the typical form (northern Japan), differing as follows:

Larger. Antennæ black, pedicel obscure yellow. Head with front and anterior vertex, with orbits, conspicuously gray; anterior vertex about one and one-third as wide as diameter of scape. Median præscutal vitta very narrow, ending as an acute

point before suture; mesal edges of scutal lobes narrowly darkened. Yellow femoral rings very narrow to subobsolete, especially on fore and middle legs, only about one-half to one-third as extensive as the broad dark tips; on posterior legs, yellow subterminal ring and darkened apex subequal. Abdomen brownish black, caudal borders of the more basal segments blackened. Ovipositor with cerci slender, moderately long.

Habitat.—China (Szechwan).

Holotype, female, Mount Omei, White Cloud Temple, altitude 9,000 feet, June 12, 1937 (*Tsen*).

LIMONIA (LIMONIA) EGRESSA sp. nov. Plate 1, fig. 18; Plate 4, fig. 42.

Mesonotal præscutum and scutum brownish yellow, posterior sclerites of notum slightly darker; flagellar segments with short glabrous apical necks; thoracic pleura with a narrow longitudinal dark stripe; legs yellow or brownish yellow; wings pale brown, oval stigma slightly darker brown; cell M_2 open by atrophy of basal section of M_3; m-cu at fork of M; male hypopygium with dististyle single, bilobed, rostral prolongation a flattened, sickle-shaped blade, its tip acute.

Male.—Length, about 5 millimeters; wing, 5.8.

Female.—Length, about 5.5 millimeters; wing, 5.5.

Rostrum brown, mouthparts paler; palpi black. Antennæ black; basal flagellar segments subglobular, with very short, stout, apical necks, outer segments oval with more slender apical pedicels; outermost segments elongate, slightly paler. Head gray.

Mesonotal præscutum and scutum obscure brownish yellow, posterior sclerites of notum somewhat darker. Pleura yellow, with a narrow, dark-brown, longitudinal stripe extending from cervical region, beneath root halteres, to abdomen. Halteres with stem pale, knob darkened. Legs with coxæ pale yellow, fore pair more infuscated; trochanters yellow; remainder of legs yellow to pale brownish yellow; claws long, with a single slender appressed spine at near midlength. Wings (Plate 1, fig. 18) with a pale-brown tinge, oval stigma slightly darker brown; veins pale brown. Venation: Sc moderately long, Sc_1 ending shortly beyond midlength of Rs, Sc_2 at its tip; free tip of Sc_2 and R_2 in transverse alignment, both pale; Rs long, nearly four times basal section of R_{4+5}; cell M_2 open by atrophy of basal section of M_3, cell 2d M_2 a little longer than its petiole; m-cu at fork of M, longer than distal section of Cu_1.

Abdomen brown, sternites more yellow, especially on basal segments. Male hypopygium (Plate 4, fig. 42) with tergite,

9*t*, narrow, caudal margin subtruncate to very feebly emarginate. Basistyle, *b*, with ventromesal lobe extensive, at apex weakly bilobed. Dististyle, *d*, small, bilobed, rostral prolongation a long, sicklelike blade, tip acute. Gonapophyses, *g*, with mesal-apical lobe slender, smooth, gently curved, tip blackened, acute. Ædeagus with apex slender, decurved.

Habitat.—China (Szechwan).

Holotype, male, Pehlüting (Beh-luh-din), altitude 6,000 feet, July 11, 1937 (*Franck*). Allotopotype, female, pinned with type. Paratopotype, female, July 9, 1937 (*Franck*).

Limonia (*Limonia*) *egressa* is entirely distinct from other regional species of the subgenus. The open cell M_2 and the structure of the male hypopygium provide strong characters for the recognition of the species.

LIMONIA (DICRANOMYIA) GRACILIROSTRIS sp. nov. Plate 1, fig. 19; Plate 4, fig. 43.

General coloration ochreous yellow; antennæ brownish black; knobs of halteres infuscated; legs yellow, terminal tarsal segments blackened; wings brownish yellow, sparsely patterned with darker; Sc_1 ending a short distance beyond origin of Rs, Sc_2 apparently lacking; m-cu at fork of M; male hypopygium with ventromesal lobe of basistyle a small rounded setiferous knob; mesal face of basistyle with a pencil of setæ; rostral prolongation of ventral dististyle unusually long and slender, the two spines at base; ædeagus unusually flattened, surface with microscopic setulæ.

Male.—Length, about 6.5 millimeters; wing, 7.6.

Rostrum brown; palpi black. Antennæ brownish black; flagellar segments oval, the first with a basal petiole; each segment with numerous verticils of moderate length on distal half of segment; terminal segment a little exceeding penultimate. Head gray.

Thorax almost uniformly ochreous yellow, præscutal stripes not or scarcely evident. Halteres pale, knobs infuscated. Legs yellow, outer tarsal segments blackened. Wings (Plate 1, fig. 19) with a brownish yellow tinge, cell C a little darker; stigma oval, pale brown, ill-defined; wing tip weakly darkened; indistinct brown clouds at origin and fork of Rs; axilla weakly darkened; veins pale brownish yellow. Venation: Sc_1 ending a short distance beyond origin of Rs, opposite or beyond one-fourth length of latter, Sc_2 not apparent; basal section of R_{4+5} long, about one-half Rs; m-cu at fork of M.

Abdominal tergites brown; basal sternites more yellow, caudal borders of segments weakly darkened; hypopygium brownish

yellow, ventral dististyle paler. Male hypopygium (Plate 4, fig. 43) with tergite, *9t*, slightly narrowed outwardly, caudal margin very gently emarginate, setæ sparse, most numerous at margin on either side of midline. Basistyle, *b*, with ventromesal lobe a small globular swelling, with numerous setæ; mesal face of style before apex with a pencil of four or five long setæ; dorsal face of style with a low flange. Dorsal dististyle a strongly curved, slender hook. Ventral dististyle, *vd*, fleshy, rostral prolongation unusually long and slender, apex acute; before apex on lower margin two pendant flattened setæ; rostral spines of moderate length, placed at base of prolongation. Gonapophyses, *g*, with mesal-apical lobe short and curved. Ædeagus, *a*, broadly flattened, outline roughly oval, surface with microscopic setulæ.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, White Cloud Temple, altitude 9,000 feet, June 12, 1937 (*Tsen*).

In the genitalic characters, especially the basistyle, ventral dististyle, and ædeagus, the present fly is entirely distinct from all other regional species of the subgenus.

ANTOCHA (ANTOCHA) EMARGINATA sp. nov. Plate 1, fig. 20; Plate 4, fig. 44.

General coloration gray, præscutum with three brown stripes; antennæ short, black; wings whitish subhyaline, prearcular field pale yellow; male hypopygium with tergite extensive, caudal margin with a deep U-shaped median notch, lateral lobes obliquely truncated; inner gonapophyses appearing as slender straight spines; outer apophyses as flattened, paddle-shaped blades.

Male.—Length, about 5 to 5.5 millimeters; wing, 5.5 to 6.7.

Rostrum dark brown; palpi black. Antennæ short, a little longer than head, black; flagellar segments oval; terminal segment about one and one-third as long as penultimate. Head gray.

Mesonotal præscutum gray, with three brown stripes, the broad median vitta ending some distance before suture and vaguely split by a pale line behind; scutal lobes darkened; posterior sclerites of notum gray. Pleura dark gray. Halteres with stem obscure yellow, knob darkened. Legs with fore coxæ darkened, remaining coxæ and trochanters obscure yellow; femora yellowish brown to pale brown; tibiæ and tarsi brown; claws (male) with a single long basal spine. Wings (Plate

1, fig. 20) whitish subhyaline, prearcular field pale yellow; stigma pale brown, ill-delimited; veins brown. Venation: R_2 about in transverse alignment with r-m; cell 1st M_2 relatively small and narrow; m-cu more than one-third its length before fork of M.

Abdomen, including hypopygium, dark brown. Male hypopygium (Plate 4, fig. 44) with tergite, *9t*, unusually extensive, broad at base, caudal margin with a deep U-shaped median notch; lateral lobes obliquely truncated, outer angles rounded; setæ restricted to lobes, lacking on median area. Outer dististyle, *od*, heavily blackened on distal portion, stem parallel-sided, apex produced into a foot-shaped enlargement. Inner dististyle, *id*, slender, simple. Inner gonapophyses appearing as nearly straight slender spines. Outer gonapophyses, *og*, long paddle-shaped blades.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, Chu Lao Tong Temple, altitude 6,500 feet, June 5, 1937 (*Tsen*). Paratype, male, Chengtu, altitude 1,800 feet, December 3, 1936 (*Franck*).

Antocha (*Antocha*) *emarginata* is readily told from other regional species by the structure of the male hypopygium, especially the tergite.

PEDICIINI

PEDICIA (TRICYPHONA) OMEIANA sp. nov. Plate 1, fig. 21; Plate 4, fig. 45.

Belongs to the *immaculata* group; general coloration gray, præscutum with three more blackish stripes, median stripe restrictedly divided behind by a pale line; antennæ 15-segmented, brownish black; femora brownish yellow, tips blackened; wings whitish subhyaline, stigma pale, very slightly indicated; veins basad of cord pale yellow, beyond cord passing into brown; cell 1st M_2 closed; male hypopygium with lateral tergal arms stout, at apex bent at a right angle into a cultriform beak; outer dististyle suboval, with peglike spines.

Male.—Length, about 6.5 to 7 millimeters; wing, 8 to 8.5.

Female.—Length, about 7.5 to 8 millimeters; wing, 8 to 8.8.

Rostrum gray; palpi black. Antennæ 15-segmented, brownish black, scape more pruinose. Head gray.

Mesonotal præscutum gray, with three more blackish stripes, median stripe restrictedly divided behind by a pale line; posterior sclerites of notum gray, centers of lobes blackened. Pleura gray. Halteres yellow, knobs scarcely darkened. Legs

with coxæ gray; trochanters brown; femora yellow to brownish yellow, tips blackened; tibiæ and basitarsi brownish yellow, tips narrowly darkened; outer tarsal segments passing into dark brown. Wings (Plate 1, fig. 21) whitish subhyaline, stigma pale, very slightly indicated; veins basad of cord pale yellow, beyond cord passing into brown. Venation: r-m connecting with R_{4+5} some distance before midlength of latter; cell 1st M_2 closed; cell M_1 present.

Abdomen, including hypopygium, dark brown, sparsely pruinose. Male hypopygium (Plate 4, fig. 45) with lateral tergal arms, *9t*, relatively stout, narrowed outwardly, at apex bent at a right angle into a cultriform beak. Apical lobe of basistyle, *b*, small. Dististyles, or lobes of a single style, superimposed over one another, outer, *od*, suboval with a chiefly marginal series of short peglike spines. Ædeagus, *a*, appearing as slender paired rods.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, Chu Lao Tong Temple, altitude 6,500 feet, June 6, 1937 (*Tsen*). Allotopotype, female. Paratopotype, 5 of both sexes.

Pedicia (*Tricyphona*) *omeiana* is most nearly allied to *P.* (*T.*) *formosana* (Alexander) and *P.* (*T.*) *glabripennis* (Brunetti), differing especially in coloration and in the structure of the male hypopygium.

HEXATOMINI

OXYDISCUS (OXYDISCUS) LATIOR sp. nov. Plate 1, fig. 22.

General coloration of mesonotum dark reddish brown, without distinct markings, pleura darker; wings with a strong dusky tinge, prearcular region and base of cell 2d A infumed; stigma dark brown; macrotrichia of outer cells relatively abundant, especially in the female, extending from cell R_2 to cell M_4; Rs gently arcuated; R_2 only a short distance beyond fork of R_{2+3+4}.

Female.—Length, about 5.5 to 6 millimeters; wing, 6 to 6.5.

Rostrum and palpi black. Antennæ black throughout; flagellar segments oval; verticils elongate. Head black, sparsely pruinose.

Thoracic dorsum dark reddish brown, without distinct markings; pleura darker brown. Halteres with stem yellow, knob brown. Legs brownish yellow to yellowish brown, outer segments scarcely darker. Wings (Plate 1, fig. 22) with a strong dusky tinge; stigma darker brown, lying distad of vein R_2; prearcular region and base of cell 2d A weakly infumed; veins

brown, more yellowish brown basad of cord. Macrotrichia of cells relatively sparse, in female occurring in the outer ends of cells R_2 to M_4 inclusive; in what appears to be male sex, less abundant, in cells R_3 to M_1 or 2d M_2. Venation: Rs gently arcuated; R_2 only a short distance beyond fork of R_{2+3+4}, R_{2+3} very short, less than R_2.

Abdomen brownish black; tips of cerci yellow. The specimen that may represent the male sex has lost the hypopygium.

Habitat.—China (Szechwan).

Holotype, female, Mount Omei, Chu Lao Tong Temple, altitude 6,500 feet, June 5, 1937 (*Tsen*). Paratopotypes, 3 females, June 5 or 6, 1937; 1, sex?, altitude 5,000 feet, June 13, 1937 (*Tsen*).

Closest to *Oxydiscus* (*Oxydiscus*) *latissimus* (Alexander), likewise from western China, differing in slight details of coloration of body and wings, and in the greater number of macrotrichia in the cells of the wing.

ERIOPTERINI

ORMOSIA INSOLITA sp. nov. Plate 1, fig. 23; Plate 4, fig. 46.

Belongs to the *aculeata* group; general coloration gray, præscutum with three broad reddish-brown stripes, posterior sclerites and pleura dark brown; femora yellow, with a narrow brown subterminal ring; wings dusky, variegated with darker-brown and extensive subhyaline areas; vein 2d A sinuous; male hypopygium with apex of basistyle unarmed; inner dististyle terminating in a long straight spine that is not strongly dilated subterminally.

Male.—Length, about 4 millimeters; wing, 4.5.

Rostrum brownish black; palpi black. Antennæ dark brown, incisures of flagellar segments restrictedly paler; flagellar segments relatively long, verticils very long, about three times segments. Head dark gray.

Mesonotum gray, præscutum with three broad reddish-brown stripes; pseudosutural foveæ and tuberculate pits black; scutal lobes reddish brown; scutellum and postnotum dark brown, sparsely pruinose. Pleura dark brown, sparsely pruinose; dorsopleural region brighter. Halteres yellow, knobs broken. Legs with coxæ dark brown; trochanters reddish brown; femora yellow with a brownish subterminal ring; remainder of legs yellow, outer tarsal segments infuscated. Wings (Plate 1, fig. 23) with ground color dusky, prearcular and costal regions light yellow; a restricted darker pattern, including stigma and

vague seams along cord, Sc_2, fork of M_{1+2}, and as tiny marginal darkenings at ends of longitudinal veins; extensive whitish areas before stigma and cord, crossing latter and involving cell 1st M_2; more restricted whitish areas beyond stigma in cell R_2 and at outer end of cell 1st A; veins pale brown, darker in clouded areas, more yellowish in luteous fields. Macrotrichia involving all cells of wing except at base (indicated in figure by stippling). Venation: R_2 just before fork of R_{3+4}; outer radial veins, especially R_3, slightly upturned at ends; vein 2d A sinuous.

Abdomen, including hypopygium, dark brown. Male hypopygium (Plate 4, fig. 46) with caudal margin of tergite gently emarginate. Basistyle, *b*, unarmed at apex. Inner dististyle, *id*, not conspicuously dilated before long, straight, apical spine, subterminal swelling with microscopic roughenings but without well-defined spines, as in *solita*.

Habitat.—China (Szechwan).

Holotype, male, Pehlüting (Beh-luh-din), altitude 6,000 feet, July 11, 1937 (*Franck*).

The present fly is closely allied to *Ormosia solita* Alexander, likewise from western China, which differs in the details of coloration and venation and especially in the structure of the male hypopygium, as the spinous tips of the basistyles and the suddenly dilated spinous head of the inner dististyle. The present species and the Formosan *O. arisanensis* Alexander differ from the other members of the *aculeata* group by the unarmed tips of the basistyles. In *arisanensis* the expanded head of the inner dististyle is perfectly smooth, not armed with accessory spines as in *solita* or roughenings as in the present fly.

MOLOPHILUS (MOLOPHILUS) BILOBULUS sp. nov. Plate 1, fig. 24; Plate 4, fig. 47.

Belongs to the *gracilis* group and subgroup; general coloration intense black; antennæ of moderate length; antennæ, halteres, and legs black; wings strongly suffused with blackish; male hypopygium with tergite produced into a flattened plate that is deeply bilobed.

Male.—Length, about 3.8 millimeters; wing, 4.3.

Rostrum and palpi black. Antennæ black throughout, of moderate length, if bent backward extending to shortly beyond wing root; flagellar segments oval; longest verticils unilaterally arranged, much longer than segments. Head black, sparsely pruinose.

Thorax uniform intense black. Halteres black. Legs brownish black. Wings (Plate 1, fig. 24) strongly suffused with blackish, especially adjoining veins; veins darker than ground. Venation: R_2 lying shortly distad of level of r-m; petiole of cell M_3 short, subequal to m-cu; vein 2d A elongate, extending to about opposite one-third length of petiole of cell M_3.

Abdomen, including hypopygium, black. Male hypopygium (Plate 4, fig. 47) with caudal margin of tergite, *9t,* produced into a depressed-flattened lobe that is narrowly split medially to form two plates, their margins microscopically roughened. Basistyle with ventral lobe, *vb,* unusually long, with sparse elongate setæ; dorsal lobe, *db,* produced into a slender, needlelike spine. Outer dististyle, *od,* strongly curved on basal third, apical portion darkened and microscopically roughened. Inner dististyle, *id,* with stem straight, apical arms relatively short.

Habitat.—China (Szechwan).

Holotype, male, Pehlüting (Beh-luh-din), altitude 6,000 feet, July 11, 1937 (*Franck*).

Molophilus bilobulus is closest to *M. albibasis* Alexander and *M. nigropolitus* Alexander, agreeing in the black coloration, differing conspicuously in the strongly blackened wings and in the structure of the male hypopygium, notably the strongly bifid tergal plate.

ILLUSTRATIONS

[Legend: *a*, Ædeagus; *b*, basistyle; *d*, dististyle; *db*, dorsal lobe of basistyle; *g*, gonapophysis; *id*, inner dististyle; *od*, outer dististyle; *og*, outer gonapophysis; *p*, phallosome; *s*, sternite; *t*, tergite; *vb*, ventral lobe of basistyle; *vd*, ventral dististyle.]

PLATE 1

FIG. 1. *Tipula gracilirostris* sp. nov.; venation.
2. *Tipula* (*Schummelia*) *bilobula* sp. nov.; venation.
3. *Tipula* (*Schummelia*) *cumulata* sp. nov.; venation.
4. *Tipula* (*Vestiplex*) *inquinata* sp. nov.; venation.
5. *Tipula* (*Vestiplex*) *subtestata* sp. nov.; venation.
6. *Tipula* (*Oreomyza*) *interrita* sp. nov.; venation.
7. *Tipula* (*Oreomyza*) *perlata* sp. nov.; venation.
8. *Tipula* (*Oreomyza*) *lætissima* sp. nov.; venation.
9. *Tipula* (*Oreomyza*) *sexlobata* sp. nov.; venation.
10. *Tipula* (*Oreomyza*) *compressiloba* sp. nov.; venation.
11. *Tipula* (*Oreomyza*) *percommoda* sp. nov.; venation.
12. *Tipula* (*Oreomyza*) *procliva* sp. nov.; venation.
13. *Tipula* (*Oreomyza*) *pertenuis* sp. nov.; venation.
14. *Dolichopeza* (*Dolichopeza*) *honshiuensis* sp. nov.; venation.
15. *Cylindrotoma megacera* sp. nov.; venation.
16. *Cylindrotoma hypopygialis* sp. nov.; venation.
17. *Limonia* (*Limonia*) *pernigrina* sp. nov.; venation.
18. *Limonia* (*Limonia*) *egressa* sp. nov.; venation.
19. *Limonia* (*Dicranomyia*) *gracilirostris* sp. nov.; venation.
20. *Antocha* (*Antocha*) *emarginata* sp. nov; venation.
21. *Pedicia* (*Tricyphona*) *omeiana* sp. nov.; venation.
22. *Oxydiscus* (*Oxydiscus*) *latior* sp. nov.; venation.
23. *Ormosia insolita* sp. nov.; venation.
24. *Molophilus* (*Molophilus*) *bilobulus* sp. nov.; venation.

PLATE 2

FIG. 25. *Tipula gracilirostris* sp. nov.; male hypopygium, ninth tergite.
26. *Tipula gracilirostris* sp. nov.; male hypopygium, dististyles.
27. *Tipula* (*Schummelia*) *bilobula* sp. nov.; male hypopygium, details.
28. *Tipula* (*Schummelia*) *cumulata* sp. nov.; male hypopygium, details.
29. *Tipula* (*Vestiplex*) *inquinata* sp. nov.; male hypopygium, dististyles.
30. *Tipula* (*Vestiplex*) *subtestata* sp. nov.; male hypopygium, details.
31. *Tipula* (*Oreomyza*) *interrita* sp. nov.; male hypopygium, details.
32. *Tipula* (*Oreomyza*) *perlata* sp. nov.; male hypopygium, details.

PLATE 3

FIG. 33. *Tipula* (*Oreomyza*) *lætissima* sp. nov.; male hypopygium, details.
34. *Tipula* (*Oreomyza*) *sexlobata* sp. nov.; male hypopygium, details.
35. *Tipula* (*Oreomyza*) *compressiloba* sp. nov.; male hypopygium, details.

FIG. 36. *Tipula (Oreomyza) percommoda* sp. nov.; male hypopygium, details.
37. *Tipula (Oreomyza) procliva* sp. nov.; male hypopygium, details.
38. *Tipula (Oreomyza) pertenuis* sp. nov.; male hypopygium, details.

PLATE 4

FIG. 39. *Dolichopeza (Dolichopeza) honshiuensis* sp. nov.; male hypopygium.
40. *Cylindrotoma hypopygialis* sp. nov.; male hypopygium.
41. *Limonia (Limonia) pernigrina* sp. nov.; male hypopygium.
42. *Limonia (Limonia) egressa* sp. nov.; male hypopygium.
43. *Limonia (Dicranomyia) gracilirostris* sp. nov.; male hypopygium.
44. *Antocha (Antocha) emarginata* sp. nov.; male hypopygium.
45. *Pedicia (Tricyphona) omeiana* sp. nov.; male hypopygium.
46. *Ormosia insolita* sp. nov.; male hypopygium.
47. *Molophilus (Molophilus) bilobulus* sp. nov.; male hypopygium.

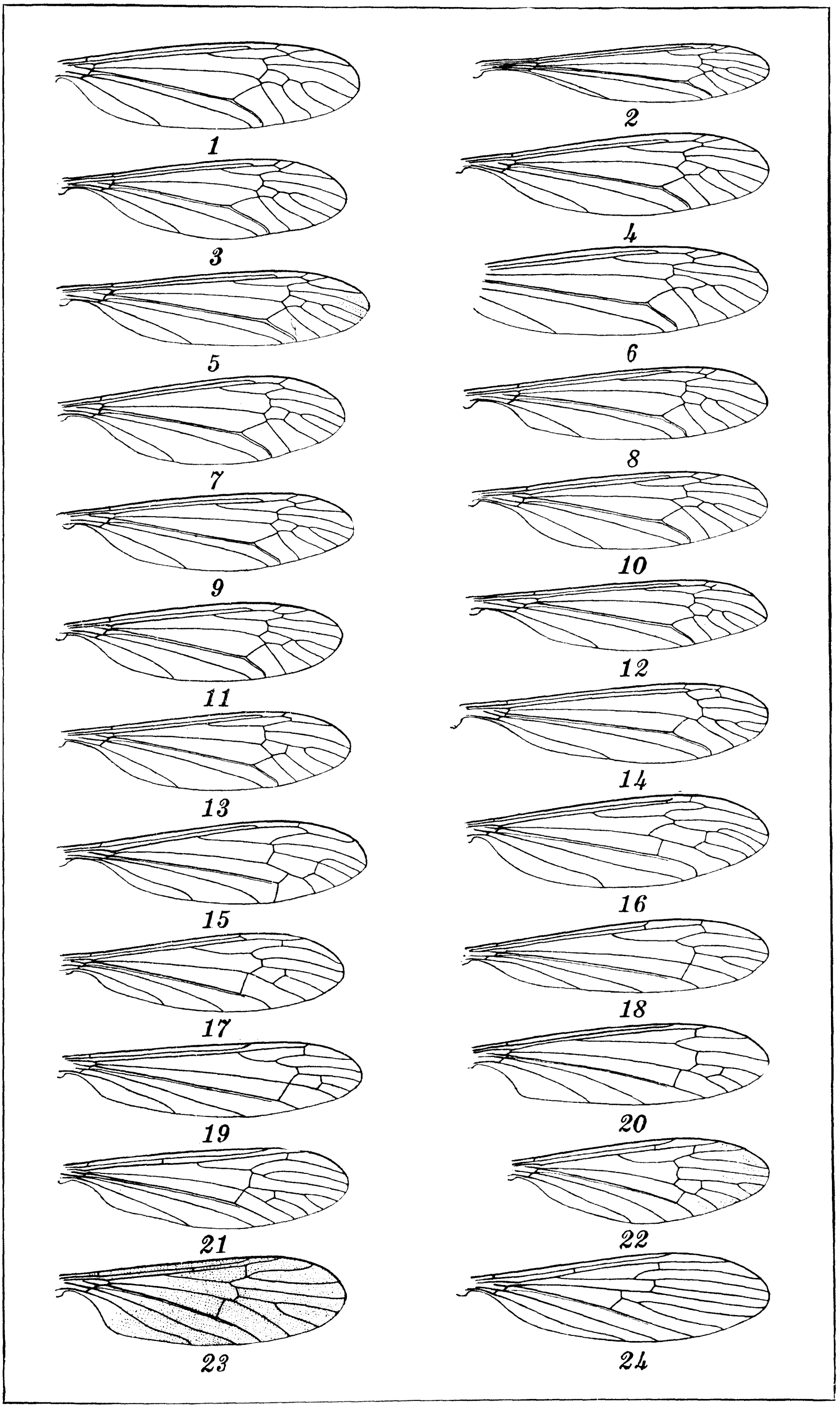

PLATE 1.

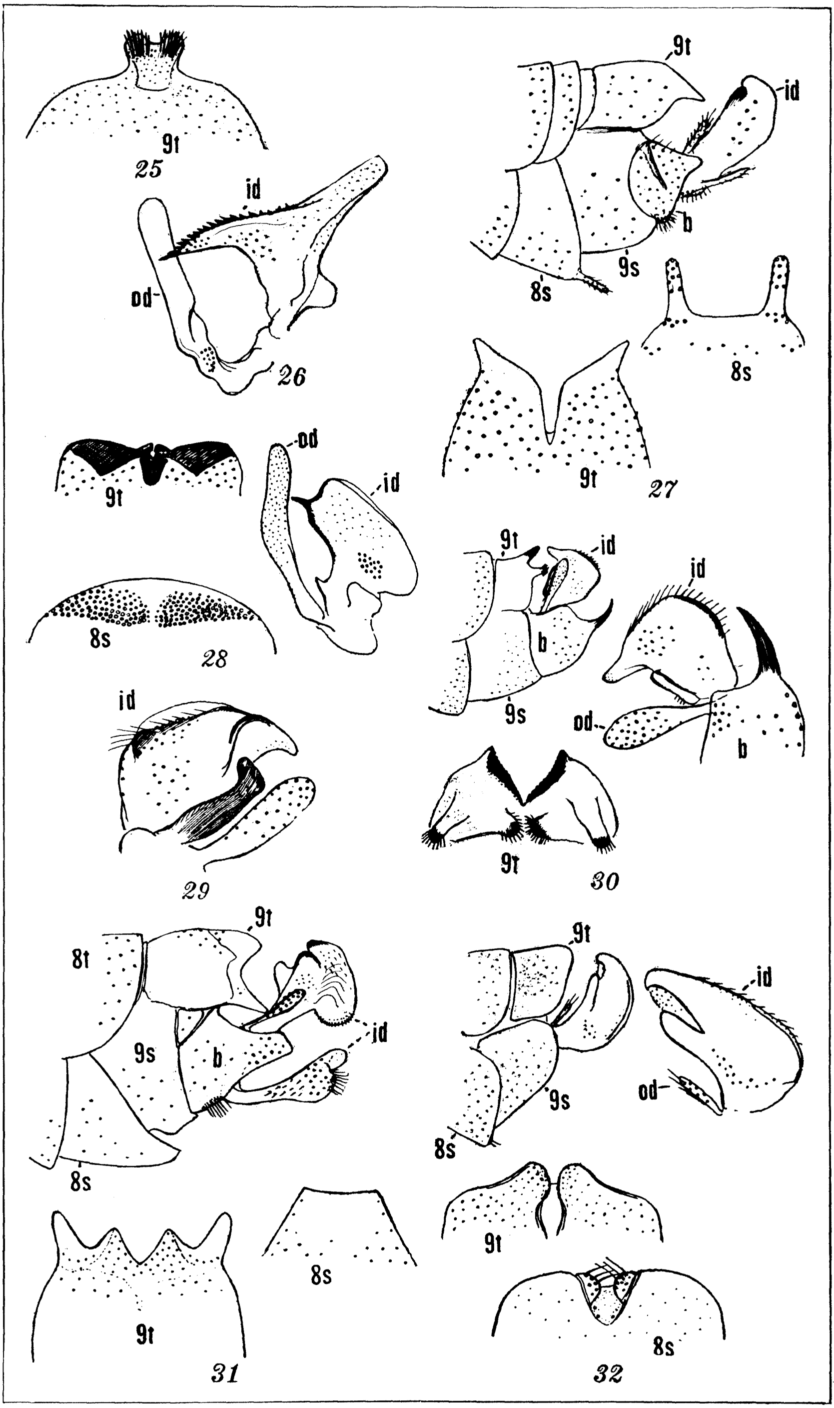
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PLATE 2.

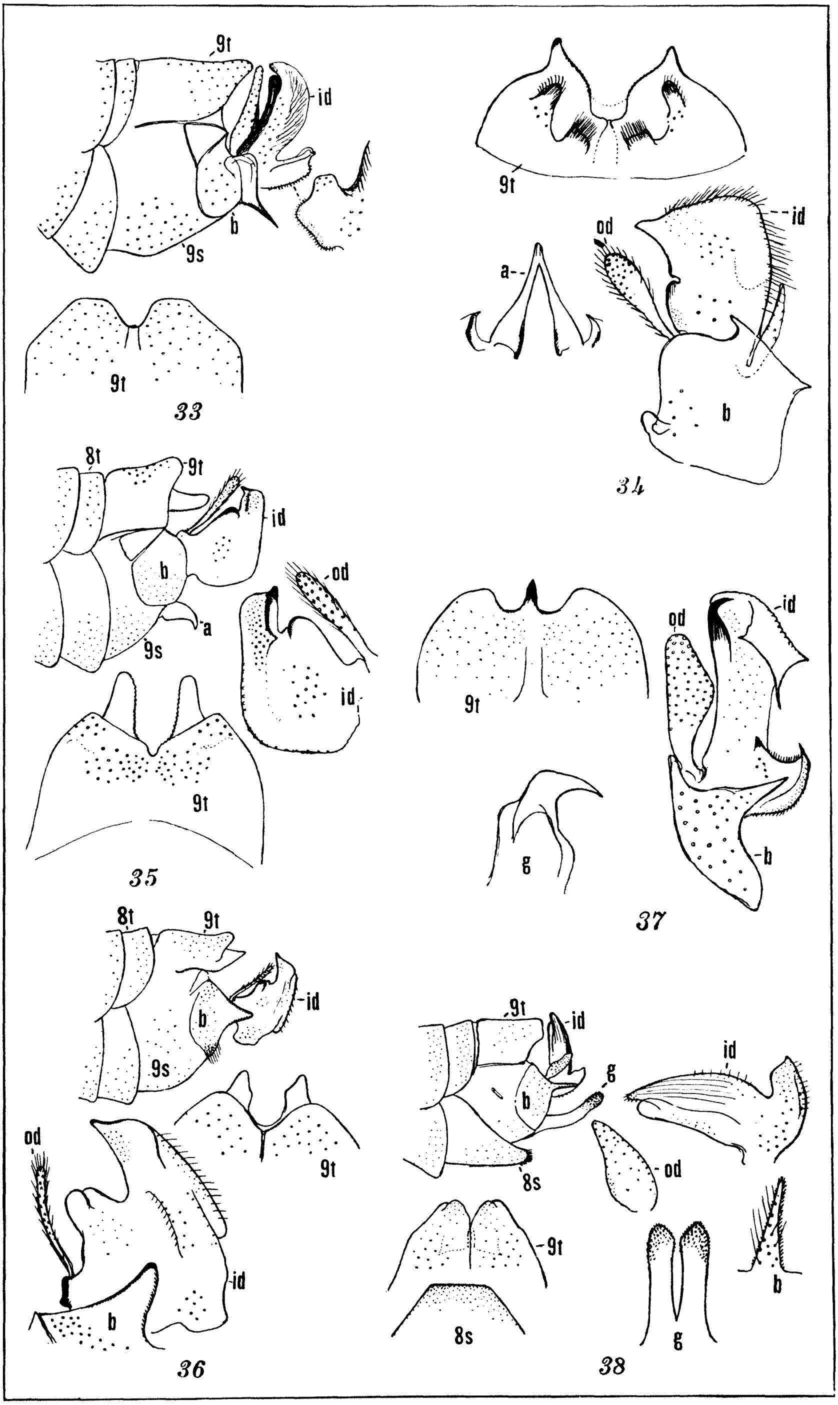
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PLATE 3.

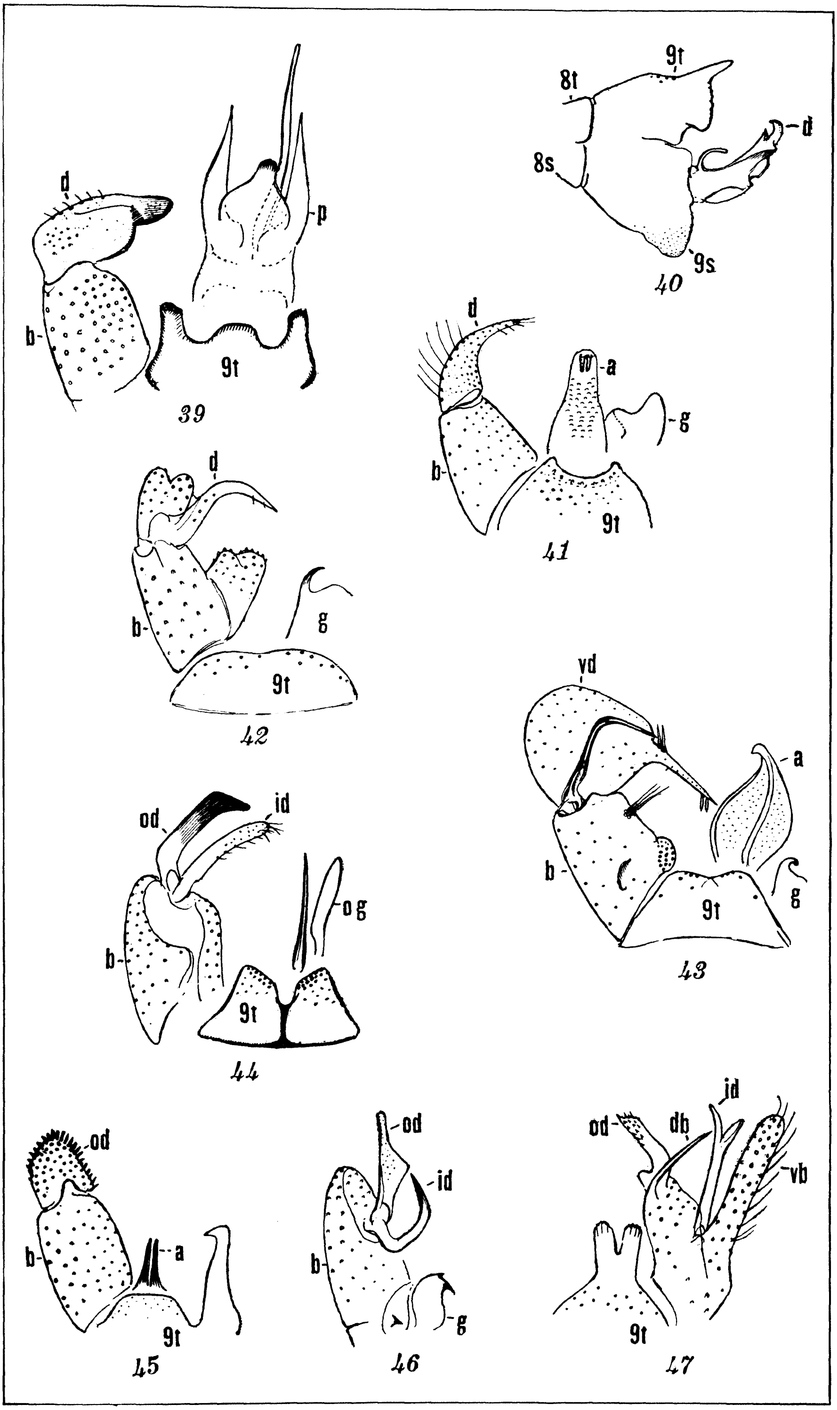
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PLATE 4.

DIATOMS FROM CHENGTU, SZECHWAN, WESTERN CHINA

By B. W. Skvortzow
Of Harbin, Manchoukuo

FOUR PLATES

Dr. H. D. Brown, of West China Union University, Chengtu, Szechwan Province, has sent me two tubes of diatom material from the environs of that city, collected in March, 1926. All samples were rich in diatoms, with predominance of species common in rapidly running water, as *Melosira varians, Diatoma vulgare, Diatoma anceps, Ceratoneis arcus, Synedra ulna, Synedra acus, Synedra vaucheriae, Synedra rumpens* var. *Meneghiniana, Synedra parasitica, Cocconeis placentula, Achnanthes sublinearis,* and *Rhoicosphenia curvata.* These species attach themselves to the submerged parts of water plants and make a rich coat on stone surfaces.

The diatom flora from Chengtu has certain peculiarities. Its general character is arctic and fresh-water. Species reported only from Central Asia and Siberia were represented in the above collection by *Achnanthes pinnata,* known from Tibet; *Amphora mongolica,* common in Kossogol and Baikal Lakes; *Cymbella Stuxbergii* var. *tumida,* the type of which is known from Siberia and Central Asia; *Didymosphenia geminata,* very common in Baikal Lake, the Altai mountains, and in northern Siberia; *Gomphonema Kaznakovi,* a species peculiar to Tibet, and others. Two beautiful tropical species have been recorded from Chengtu; namely, *Gomphonema tropicale,* reported only from Mekong River, India, and *Surirella bengalensis,* known from Bengal, India, and Tokyo, Nippon. Two marine diatoms, *Actinocyclus Ehrenbergii* Ralfs var. *crassa* (W. Smith) Hustedt and *Diploneis Bombus* Ehr. var. *egena* A. S., have been recorded from the above collection. The first is a minute marine species reported from European coasts.

The diatoms from Chengtu have never been listed and so may be of interest. The species found in the collection from this region are enumerated below.

MELOSIRA VARIANS Agardh.

Melosira varians Agardh, FR. HUSTET, Bacillar. (1930) 85, fig. 41.

Common in mountain regions.

CYCLOTELLA MENEGHINIANA Kützing var. LAEVISSIMA (van Goor) Hustedt.

Cyclotella Meneghiniana Kützing var. *laevissima* (van Goor) FR. HUSTEDT, Kieselalgen 7, Lief. 2 (1928) 342.

Cyclotella Meneghiniana Kützing var. *tenera* KOLBE, Diatom. Sperenb. Salzgeb. (1927) 33, pl. 1, figs. 17, 18; SKVORTZOW, Diatoms from Poyang Lake, Hunan, China (1935) 465, pl. 1, fig. 2.

Valve diameter 0.015 mm, with four puncta in the central area. Rare.

ACTINOCYCLUS EHRENBERGII Ralfs var. CRASSA (W. Smith) Hustedt. Plate 2, fig. 4.

Actinocyclus crassus VAN HEURCK, Synopsis (1880–1881) pl. 124, figs. 6, 8.

Actinocyclus subcrassus RATTRAY, A revision of the Genus *Actinocyclus* Ehr. (1890) 154.

Diameter 0.037 to 0.04 mm. Valve surface subplain, separated into four areas. The central area with large radiating beads or markings, the submarginal area with coarse beads, the second submarginal area with indistinct coarse beads and the border a narrow rim. Color pale gray, with green-blue markings and pseudonodule. Markings of central area rounded, granular, subequal, diminishing slightly outward to the submarginal area or zone, 7 to 8 in 0.01 mm. Markings upon the first submarginal area suddenly reduced in size, arranged in quincunx, about 17 to 19 in 0.01 mm; rows radiate, inconspicuous within the submarginal area, secondary undulating bands discernible. Apiculi minute, indistinct, discernible with difficulty in same valves. Border distinct, with striæ 18 in 0.01 mm. Pseudonodule 0.0015 to 0.0018 mm in diameter, at inner edge of submarginal areas. Several valves.

A minute *Actinocyclus* species reported from European coasts and very common in brackish waters of the Caspian sea. Reported as a fossil in Hungary, Europe. Also reported in mouths of large rivers with brackish water. A related form, *Actinocyclus Ehrenbergii* Ralfs var. *sparsa* (Greg.) Hustedt, was recently found by the author in a brackish-water stagnant pool near Soochow, China.

DIATOMA VULGARE Bory. Plate 3, fig. 15.

Diatoma vulgare Bory, A. SCHMIDT, Atlas Diatom (1906) pl. 268, fig. 4.

Very abundant. Common in mountain districts.

DIATOMA ANCEPS (Ehr.) Grun. Plate 3, figs. 8 and 9.

Diatoma anceps (Ehr.) Grun., A. SCHMIDT, Atlas Diatom. (1906) pl. 267, fig. 50.

Length, 0.013 to 0.024 mm; breadth, 0.0036 to 0.0042. Costæ 5 to 7 in 0.01 mm. Infrequent. Known in rapidly running water.

CERATONEIS ARCUS Kütz.

Ceratoneis arcus Kütz., FR. HUSTEDT, Bacillar. (1930) 135, fig. 122.

Valve lunate. Length, 0.049 mm; breadth, 0.0042. Striæ 12 to 14 to 0.01 mm. Rare. Reported from mountain districts.

SYNEDRA ULNA (Nitz.) Ehr.

Synedra ulna (Nitz.) Ehr., FR. HUSTEDT, Bacillar. (1930) 151, figs. 158, 159.

Valve lanceolate-linear. Length, 0.09 to 0.156 mm; breadth, 0.0068 to 0.0085. Striæ 10 to 12 in 0.01 mm. Abundant.

SYNEDRA ULNA (Nitz.) Ehr. var. **LANCEOLATA** Kütz. fo. **CONSTRICTA** fo. nov. Plate 4, fig. 10.

Length, 0.093 mm; breadth, 0.007. Striæ 11 in 0.01 mm. Differs from the type [1] in its slightly constricted valves. The type is reported from Java.

SYNEDRA ULNA (Nitz.) Ehr. var. **TENUIROSTRIS** var. nov. Plate 3, figs. 25 to 27, and 29.

Valve linear-lanceolate, with abruptly rostrate ends. Length, 0.042 to 0.072 mm; breadth, 0.0068 to 0.007. Striæ 12 to 13 in 0.01 mm. A variety akin to var. *lanceolata* Kütz.[2] Infrequent.

SYNEDRA ULNA (Nitz.) Ehr. var. **AMPHIRHYNCHUS** (Ehr.) Grun.

Synedra ulna (Nitz.) Ehr. var. *amphirhynchus* (Ehr.) Grun., FR. HUSTEDT, Bacillar. (1930) 154, fig. 167.

Length, 0.17 mm; breadth, 0.0068. Striæ 8 to 9 in 0.01 mm. Uncommon.

SYNEDRA ACUS Kützing.

Synedra acus Kützing, FR. HUSTEDT, Bacillar. (1930) 155, fig. 170.

Length, 0.036 mm; breadth, 0.0048. Striæ 12 in 0.01 mm. Rare. A fresh-water diatom.

SYNEDRA VAUCHERIAE Kützing. Plate 4, figs. 1 to 4.

Synedra vaucheriae Kützing, FR. HUSTEDT, Bacillar. (1930) 161, fig. 192.

[1] A. Schmidt, Atlas Diatom. (1914) pl. 302, fig. 16.

[2] Tom. cit., pl. 302, fig. 17.

Length, 0.018 to 0.039 mm; breadth, 0.0035 to 0.005. Striæ 11 to 14 in 0.01 mm. Abundant.

SYNEDRA VAUCHERIAE Kütz. var. **CAPITATA** var. nov. Plate 4, fig. 11.

Valve linear-lanceolate, with capitate ends. Length, 0.023 mm; breadth, 0.0034. Striæ 12 in 0.01 mm. Differs from var. *capitellata* in its rostrate ends. Rare.

SYNEDRA RUMPENS Kützing var. **MENEGHINIANA** Grun.

Synedra rumpens Kützing var. *Meneghiniana* Grun., FR. HUSTEDT (1930) 156, fig. 178.

Length, 0.064 mm; breadth, 0.0042. Striæ 12 in 0.01 mm. Infrequent.

SYNEDRA PARASITICA W. Smith.

Synedra parasitica (W. Smith), FR. HUSTEDT, Bacillar. (1930) 161, fig. 195.

Length, 0.0187 mm; breadth, 0.0034. Striæ 15 in 0.01 mm. Rare.

COCCONEIS PLACENTULA (Ehr.) var. **EUGLYPTA** (Ehr.) Cleve.

Cocconeis placentula (Ehr.) var. *euglypta* (Ehr.) Cleve, FR. HUSTEDT, Bacillar. (1930) 190, fig. 261.

Length, 0.017 mm; breadth, 0.0068. Striæ 18 in 0.01 mm. Infrequent.

COCCONEIS PLACENTULA (Ehr.) var. **LINEATA** (Ehr.) Cleve.

Cocconeis placentula (Ehr.) var. *lineata* (Ehr.) Cleve, FR. HUSTEDT, Bacillar. (1930) 190, fig. 262.

Valve 0.02 to 0.047 mm; breadth, 0.015 to 0.03. Striæ 20 to 25 in 0.01 mm. Very abundant.

ACHNANTHES PINNATA Hustedt. Plate 3, figs. 17 and 18.

Achnanthes pinnata FR. HUSTEDT, Bacillar. aus Innerasien (1922) 123, pl. 9, figs. 15–18.

Length, 0.006 mm; breadth, 0.003. Striæ radiate, 18 in 0.01 mm. Infrequent. Known from Tibet.

ACHNANTHES MICROCEPHALA Kützing.

Achnanthes microcephala Kütz., FR. HUSTEDT, Bacillar. (1930) 198, fig. 273.

Length, 0.012 mm; breadth, 0.0025. Common.

ACHNANTHES AFFINIS Grun. var. **BISTRIATA** var. nov. Plate 3, fig. 7.

Valve elliptic-lanceolate, with broad-rounded ends. Lower valve with broad rectangular central area. Length, 0.01 mm;

breadth, 0.002. Striæ 25 to 30 in 0.01 mm. Differs from the type in the presence of single striæ on both sides of the central area. Abundant.

ACHNANTHES SUBLINEARIS sp. nov. Plate 3, figs. 11 to 14, and 28.

Valve linear-elliptic, sometimes constricted, with broad-rounded ends. Length, 0.012 to 0.019 mm; breadth, 0.0032 to 0.0037. Upper valve with narrow-linear axial and central area. Striæ parallel or slightly radiate, 15 to 18 in 0.01 mm. Lower valve with narrow linear axial area and rectangular central area. Striæ shortened and more distinct in the middle part of the valve. Differs from *Achnanthes minutissima* Kütz. and *Achnanthes linearis* W. Smith in its more robust striæ. Abundant.

ACHNANTHES SUBLINEARIS sp. nov. var. **ELLIPTICA** var. nov. Plate 3, fig. 23.

Differs from the type in its elliptic valves. Length, 0.013 mm; breadth, 0.0034. Striæ 15 in 0.01 mm. Abundant.

ACHNANTHES SUBLINEARIS sp. nov. var. **COMPLEXA** var. nov. Plate 3, figs. 5, 6, and 22.

Differs from the type in its narrow-linear central area and in having striæ of unequal length in the middle part of the valve. Length, 0.015 to 0.02 mm; breadth, 0.0034 to 0.005. Striæ 15 to 18 in 0.01 mm. Abundant.

RHOICOSPHENIA CURVATA (Kütz.) Grunow.

Rhoicosphenia curvata (Kütz.) Grunow, FR. HUSTEDT, Bacillar. (1930) 211, fig. 311.

Length, 0.034 mm; breadth, 0.0085. Rare.

FRUSTULIA VULGARIS Thwaite.

Frustulia vulgaris Thwaite, FR. HUSTEDT, Bacillar. (1930) 221, fig. 327.

Length, 0.044 mm; Breadth, 0.0085. Rare.

GYROSIGMA ACUMINATUM (Kütz.) Rabh.

Gyrosigma acuminatum (Kütz.) Rabh., FR. HUSTEDT, Bacillar. (1930) 222, fig. 329.

Length, 0.124 mm; breadth, 0.017. Longitudinal and transverse striæ 15 in 0.01 mm. Uncommon.

GYROSIGMA SCALPROIDES (Rabh.) Cleve.

Gyrosigma scalproides (Rabh.) Cleve, FR. HUSTEDT, Bacillar. (1930) 226, fig. 338.

Length, 0.06 mm; breadth, 0.01. Uncommon.

GYROSIGMA ATTENUATUM (Kütz.) Rabh. var. **ASIATICA** var. nov. Plate 4, fig. 8.

Valve gently sigmoid, lanceolate, gradually tapering from the middle to the obtuse ends. Length, 0.22 to 0.225 mm;

breadth, 0.028. Longitudinal striæ 7 to 8, transverse 11 to 12 in 0.01 mm. Differs from the type in its more robust transverse striæ. Common.

CALONEIS SILICULA (Ehr.) Cleve var. TRUNCATULA Grunow.

Caloneis silicula (Ehr.) Cleve var. *truncatula* Grunow, FR. HUSTEDT, Bacillar. (1930) 238, fig. 364.

Length, 0.051 mm; breadth, 0.012. Striæ 15 in 0.01 mm. Infrequent.

CALONEIS BACILLUM (Grun.) Mereschkovski.

Caloneis bacillum (Grun.) Mereschkovski, FR. HUSTEDT, Bacillar. (1930) 236, fig. 360*a*.

Length, 0.032 mm; breadth, 0.0068. Striæ 21 in 0.01 mm. Infrequent.

CALONEIS PATAGONICA Cleve var. SINICA var. nov. Plate 4, fig. 20.

Valve convex, linear, with cuneate ends. Length, 0.068 mm; breadth, 0.01. Axial area broad, central a broad fascia, reaching to the margins. Striæ about 18 in 0.01 mm, almost parallel and radiate at the ends. No longitudinal line near the margins. Differs from the type in its coarser striæ and in the absence of a longitudinal band. The type is known from fresh water, on moist rocks, Sierra Famatima, Argentina, Pichincha, Ecuador.[3]

DIPLONEIS BOMBUS Ehr. var. EGENA A. S. Plate 2, fig. 11.

Diploneis bombus Ehr. var. *egena* A. S., A. SCHMIDT, Atlas Diatom. (1875) pl. 13, fig. 10.

Valve deeply constricted. Length, 0.042 mm; breadth, 0.018. Central nodule large. Transverse costæ 6 to 9 in 0.01 mm, crossed on each side of the median line by about three longitudinal costæ. Several frustules observed. A marine diatom, known from Nippon sea and from Manila.

DIPLONEIS OVALIS (Hilse) Cleve var. OBLONGELLA (Naeg.) Cleve.

Diploneis ovalis (Hilse) Cleve var. *oblongella* (Naeg.) Cleve, FR. HUSTEDT, Bacillar. (1930) 249, fig. 391.

Length, 0.24 mm; breadth, 0.0085. Striæ 15 in 0.01 mm. Rare.

STAURONEIS PHOENICENTERON Ehr.

Stauroneis phoenicenteron Ehr., FR. HUSTEDT, Bacillar. (1930) 255, fig. 404.

[3] Cleve, P., Farskvattens Diatomaceer fram Gronland och Argentinska republiken. Stockholm (1811).

Length, 0.074 mm; breadth, 0.015. Striæ 18 in 0.01 mm. Rare.

STAURONEIS SMITHII Grunow.

Stauroneis Smithii Grunow, FR. HUSTEDT, Bacillar. (1930) 261, fig. 420.

Length, 0.018 mm; breadth, 0.0045. Rare.

NAVICULA PUSIO Cleve. Plate 4, fig. 21.

Navicula pusio P. CLEVE, Synopsis Navicul. Diatoms (1895) 9, pl. 3, fig. 3.

Length, 0.015 mm; breadth, 0.0085. Rare. Reported from New Zealand and from Nippon.

NAVICULA CRYPTOCEPHALA Kütz. var. VENETA (Kütz.) Grunow.

Navicula cryptocephala Kütz. var. *veneta* (Kütz.) Grunow, FR. HUSTEDT, Bacillar. (1930) 295, fig. 497*a*.

Length, 0.02 mm; breadth, 0.006. Striæ 15 in 0.01 mm. Rare.

NAVICULA SALINARUM Grunow forma. Plate 4, fig. 5.

Navicula salinarum Grunow forma, FR. HUSTEDT, Bacillar. (1930) 295, fig. 498.

Length, 0.027 mm; breadth, 0.0068. Striæ 15 in 0.01 mm. Differs from the type in its narrower valves. Infrequent.

NAVICULA RHYNCHOCEPHALA Kütz. var. TENUA var. nov. Plate 3, fig. 24; Plate 4, fig. 13.

Valve lanceolate, gradually tapering to subcapitate ends. Length, 0.017 to 0.032 mm; breadth, 0.005 to 0.0068. Striæ radiate, 14 to 15 in 0.01 mm. Axial area narrow linear, central suborbicular, broad. Differs from the type in its narrower valves. Infrequent.

NAVICULA CINCTA (Ehr.) Kützing.

Navicula cincta (Ehr.) Kützing, FR. HUSTEDT, Bacillar. (1930) 288, fig. 510.

Length, 0.029 mm; breadth, 0.0065. Striæ 14 in 0.01 mm. Uncommon.

NAVICULA GRACILIS Ehr.

Navicula gracilis Ehr., FR. HUSTEDT, Bacillar. (1930) 299, fig. 514.

Length, 0.052 mm; breadth, 0.009. Striæ not lineate, 9 in 0.01 mm. Infrequent.

NAVICULA PEREGRINA (Ehr.) Kützing. Plate 4, fig. 22.

Navicula peregrina (Ehr.) Kützing, FR. HUSTEDT, Bacillar. (1930) 300, fig. 516.

Length, 0.062 to 0.072 mm; breadth, 0.013 to 0.015. Striæ 6 in 0.01 mm. Infrequent.

NAVICULA PEREGRINA (Ehr.) Kütz. var. SINICA var. nov. Plate 2, figs. 15 and 16.

Valve linear-lanceolate, with subrostrate ends. Length, 0.042 to 0.054 mm; breadth 0.0085 to 0.01. Striæ lineate, 7 to 8 in 0.01 mm. Differs from the type in it valves with parallel margins and its shortened striæ in the middle part of the valve. Infrequent.

NAVICULA CRYPTOCEPHALA Kütz. var. EXILIS Kützing forma. Plate 2, fig. 14.

Navicula cryptocephala Kütz. var. *exilis* Kützing forma, VAN HEURCK, Synopsis (1881) 85, pl. 8, figs. 2, 4.

Somewhat shorter, striæ coarser than in the type. Length, 0.012 mm; breadth, 0.0042. Striæ 20 to 22 in 0.01 mm. Infrequent.

NAVICULA REINHARDTII Grun. fo. GRACILIOR Grunow.

Navicula Reinhardtii Grun. fo. *gracilior* Grunow, FR. HUSTEDT, Bacillar. (1930) 301.

Length, 0.47 mm; breadth, 0.015. Striæ 8 to 11 in 0.01 mm. Rare.

NAVICULA HASTA Pantocsek.

Navicula hasta Pantocsek, FR. HUSTEDT, Bacillar. (1930) 306, fig. 541.

Length, 0.066 mm; breadth, 0.013. Striæ 7 to 8 in 0.01 mm. Infrequent.

NAVICULA FALAISIENSIS Grun. var. LANCEOLATA Grun.

Navicula falaisiensis Grun. var. *lanceolata* Grun., FR. HUSTEDT, Bacillar. (1930) 302, fig. 525.

Length, 0.02 mm; breadth, 0.0038. Striæ 20 in 0.01 mm. Infrequent.

NAVICULA AMPHIBOLA Cleve.

Navicula amphibola Cleve, FR. HUSTEDT, Bacillar. (1930) 309, 310, fig. 554.

Length, 0.039 mm; breadth, 0.012. Striæ 11 to 12 in 0.01 mm. Infrequent.

PINNULARIA VIRIDIS (Nitz.) Ehr.

Pinnularia viridis (Nitz.) Ehr., FR. HUSTEDT, Bacillar. (1930) 334, fig. 617*a*.

Length, 0.119 mm; breadth, 0.022. Striæ 7 in 0.01 mm. Rare.

AMPHIPHORA ORNATA Bailey.

Amphiphora ornata BAILEY, Microscop. observations made in South Carolina, Georgia and Florida (1850) 38, pl. 2, fig. 15.

Length, 0.49 mm; breadth, 0.022. Rare. A fresh-water species, reported from lakes.

AMPHORA OVALIS Kützing.

Amphora ovalis Kützing, FR. HUSTEDT, Bacillar. (1930) 342, fig. 628.

Length, 0.054 mm; breadth, 0.022. Striæ 22 in 0.01 mm. Uncommon.

AMPHORA OVALIS Kützing var. PEDICULUS Kützing.

Amphora ovalis Kütz. var. *pediculus* Kützing, FR. HUSTEDT, Bacillar. (1930) 343, fig. 629.

Length, 0.017 mm; breadth, 0.0068. Striæ 15 in 0.01 mm. Rare.

AMPHORA OVALIS Kütz. var. LIBYCA (Ehr.) Cleve. Plate 4, fig. 18.

Amphora ovalis Kütz. var. *libyca* (Ehr.) Cleve, A. SCHMIDT, Atlas Diatom. (1876) pl. 26, fig. 105.

Length, 0.03 to 0.057 mm; breadth, 0.0085 to 0.015. Striæ 8 to 9 in 0.01 mm. Infrequent.

AMPHORA MONGOLICA Oestrup. Plate 4, fig. 9.

Amphora mongolica Oestrup, Beiträge zur Kenntniss der Diatomeenflora des Kossogolbeckens in der nordwestlichen Mongolei. (1909) pl. 1, fig. 1.

Length, 0.093 mm; breadth, 0.025. Rare. Reported from Kossogol and Baikal Lakes.

CYMBELLA RUPICOLA Grunow. Plate 2, fig. 5.

Cymbella rupicola Grunow, FR. HUSTEDT, Bacillar. (1930) 353, fig. 655.

Length, 0.03 mm; breadth, 0.0068. Striæ, ventral 15 to 16, dorsal 13 to 14 in 0.01 mm. Common.

CYMBELLA HYBRIDA Grunow. Plate 3, fig. 16.

Cymbella hybrida Grunow, FR. HUSTEDT, Bacillar. (1930) 357, fig. 652.

Length, 0.032 to 0.034 mm; breadth, 0.009 to 0.01. Striæ 11 to 12 in 0.01 mm. Differs from the type in its somewhat undulate margins. Common.

CYMBELLA AFFINIS Kützing.

Cymbella affinis Kützing, FR. HUSTEDT, Bacillar. (1930) 362, fig. 671.

Length, 0.027 mm; breadth, 0.0068. Striæ, dorsal 10, ventral 11 to 12 in 0.01 mm. Uncommon.

CYMBELLA AFFINIS Kützing var. EXCISA (Kütz.) Grunow.

Cymbella affinis Kütz. var. *excisa* (Kütz.) GRUNOW, Beiträge zur Kenntniss der fossilen Diatom. Oester.-Ungarns, pl. 29, fig. 26.

Length, 0.022 mm; breadth, 0.0068. Striæ, 9 in 0.01 mm. Rare. Fossil from Hungary and recent from Koukounor District.

CYMBELLA VENTRICOSA Kützing.

Cymbella ventricosa Kützing, FR. HUSTEDT, Bacillar. (1930) 359, fig. 661.

Length, 0.025 mm; breadth, 0.0085. Common.

CYMBELLA SEMICIRCULARIS Lagerstedt. Plate 3, fig. 21.

Cymbella affinis Kütz. var. *semicircularis* LAGERSTEDT, Sotvatt. Diatom. Spitsbergen, 43, pl. 2, fig. 20.

Length, 0.018 mm; breadth, 0.006. Striæ, dorsal 8, ventral 12 in 0.01 mm. Rare. Known from Spitsbergen and Koukounor District.

CYMBELLA TUMIDULA Grun. fo. RECTA fo. nov. Plate 1, fig. 13.

Valve asymmetric, with dorsal margin arcuate and ventral straight. Length, 0.034 mm; breadth, 0.0085. Striæ, ventral 10, dorsal 9 in 0.01 mm. Differs from the type in it straight ventral margin. Uncommon.

CYMBELLA CUSPIDATA Kützing.

Cymbella cuspidata Kützing, FR. HUSTEDT, Bacillar. (1930) 357, fig. 650.

Length, 0.062 mm; breadth, 0.02. Striæ, ventral 8, dorsal 6 in 0.01 mm. Not rare.

CYMBELLA CISTULA (Hem.) Grunow.

Cymbella cistula var. *eucistula* Mayer fo. *typica* Meister, A. MAYER, Bacillar. Regensb. Gewässer (1913) fig. 25*a*.

Length, 0.076 mm; breadth, 0.017. Uncommon.

CYMBELLA STUXBERGII Cleve var. TUMIDA var. nov. Plate 2, figs. 8 and 9.

Valve arcuate, with slightly convex ventral margin and long, subrostrate, obtuse ends. Length, 0.078 to 0.144 mm; breadth, 0.02 to 0.025. Striæ, ventral 8.5 to 9, dorsal 7 in 0.01 mm. Differs from var. *intermedia* Wisl. from Baikal Lake in it broader, more truncate ends. Common.

CYMBELLA TUMIDA (Breb.) Van Heurck. Plate 2, fig. 12; Plate 4, fig. 15.

Cymbella tumida (Breb.) Van Heurck, A. SCHMIDT, Atlas Diatom. (1931) pl. 376, fig. 4.

Length, 0.056 to 0.085 mm; breadth, 0.013 to 0.018. Striæ 9 in 0.01 mm. Uncommon.

CYMBELLA TUMIDA (Breb.) Van Heurck var. **BOREALIS** Grunow.

Cymbella tumida (Breb.) Van Heurck var. *borealis* Grunow, SKVORTZOW, Die Bacillar. des Hankasees (1929) pl. 7, fig. 3.

Length, 0.081 mm; breadth, 0.019. Striæ 9 in 0.01 mm. Uncommon.

CYMBELLA SINICA sp. nov. Plate 1, fig. 7; Plate 2, fig. 6; Plate 4, fig. 17.

Valve slightly asymmetric, naviculiform, with slightly convex dorsal and ventral margins. Median line moderately oblique. Axial area narrow, central area distinct on the ventral side and forming a broad fascia on the dorsal side, sometimes with one isolated middle stria. Length, 0.032 to 0.035 mm; breadth, 0.0068. Striæ, ventral 12 to 13, dorsal 15 in 0.01 mm. A distinct species, akin to *Cymbella naviculiformis* Auers.

DIDYMOSPHENIA GEMINATA (Lyngb.) M. Schmidt. Plate 2, fig. 3.

Didymosphenia geminata (Lyngb.) M. Schmidt, A. SCHMIDT, Atlas Diatom. (1899) pl. 214, figs. 7–9.

Length, 0.093 mm; breadth, 0.037. Striæ 8 in 0.01 mm. Uncommon. An arctic diatom.

GOMPHONEMA ACUMINATUM Ehr. var. **CORONATA** (Ehr.) W. Smith.

Gomphonema acuminatum Ehr. var. *coronata* (Ehr.) W. Smith, FR. HUSTEDT, Bacillar. (1930) 370, fig. 684.

Length, 0.045 mm.; breadth, 0.01. Striæ 10 in 0.01 mm. Rare.

GOMPHONEMA GRACILE Ehr.

Gomphonema gracile Ehr., FR. HUSTEDT, Bacillar. (1930) 376, fig. 702.

Length, 0.042 mm; breadth, 0.0085. Striæ 12 in 0.01 mm. Rare.

GOMPHONEMA PARVULUM (Kütz.) Grunow.

Gomphonema parvulum (Kütz.) Grunow, FR. HUSTEDT, Bacillar. (1930) 372, fig. 713*a*.

Length, 0.023 mm; breadth, 0.006. Striæ 12 to 14 in 0.01 mm. Infrequent.

GOMPHONEMA PARVULUM (Kütz.) Grunow var. EXILISSIMA Grunow.

Gomphonema parvulum (Kütz.) Grunow var. *exilissima* Grunow, FR. HUSTEDT, Bacillar. (1930) 373; VAN HEURCK, Synopsis (1880–1885) pl. 25, fig. 12.

Length, 0.02 mm; breadth, 0.0042. Striæ 13 to 14 in 0.01 mm. Rare.

GOMPHONEMA TERGESTINUM (Grun.) Fricke. Plate 1, fig. 8.

Gomphonema tergestinum (Grun.) Fricke, FR. HUSTEDT, Bacillar. (1930) 377, fig. 717.

Length, 0.015 mm; breadth, 0.005. Striæ 15 in 0.01 mm. Rare. Known from Europe.

GOMPHONEMA INTRICATUM Kützing. Plate 2, fig. 13; Plate 4, fig. 16.

Gomphonema intricatum Kützing, FR. HUSTEDT, Bacillar. (1930) 375, fig. 697.

Length, 0.024 to 0.034 mm; breadth, 0.004 to 0.0055. Striæ 9 to 12 in 0.01 mm. Fairly common.

GOMPHONEMA LONGICEPS Ehr. var. SUBCLAVATA Grunow. Plate 1, figs. 6, 9, and 11.

Gomphonema subclavatum Grunow, A. SCHMIDT, Atlas Diatom. (1902) pl. 237, figs. 31, 32, 34.

Length, 0.018 to 0.029 mm; breadth, 0.006 to 0.0068. Striæ 10 to 11 in 0.01 mm. Very common.

GOMPHONEMA LANCEOLATUM Ehr. Plate 1, fig. 12.

Gomphonema lanceolatum Ehr., A. SCHMIDT, Atlas Diatom. (1902) pl. 237, fig. 1.

Length, 0.042 mm; breadth, 0.008. Striæ about 8.5 in 0.01 mm. Common. An alpine diatom.

GOMPHONEMA OLIVACEUM (Lyngb.) Kützing.

Gomphonema olivaceum (Lyngb.) Kützing, FR. HUSTEDT, Bacillar. (1930) 378, fig. 719.

Length, 0.023 mm; breadth, 0.007. Striæ 12 in 0.01 mm. Common.

GOMPHONEMA HEIDENI Hust. var. SINICA var. nov. Plate 4, fig. 12.

Valve clavate, with apex broader than basis. Length, 0.025 mm; breadth, 0.0065. Striæ radiate, 10 in 0.01 mm. Axial area narrow-linear, central area unilateral. No isolated puncta. Differs from the type[4] from Jones Valley, Nevada, North America, in its broad upper part and in the number of striæ. Rare.

[4] A. Schmidt, Atlas Diatom. (1904) pl. 248, figs. 29–33.

GOMPHONEMA KAZNAKOWI Mereschkovski. Plate 1, figs. 10 and 14; Plate 2, figs. 1 and 2.

Gomphonema Kaznakowi MERESCHKOVSKI, Diatoms from Tibet (1906) 22, fig. 14.

Valve slightly clavate or lanceolate-clavate, with much narrower basis. Median line filiform, convex in the middle part with bayonet-shaped terminal fissures and comma-shaped transverse fissures near the central pores. Axial narrow-linear, central area unilateral with shortened striæ on one side. Length, 0.061 to 0.102 mm; breadth, 0.011 to 0.013. Middle striæ 5 to 7, end striæ 8 to 10 in 0.01 mm. Striæ distinctly lineate. Common. Known from Tibet only.

GOMPHONEMA KAZNAKOWI Mereschkovski var. **DISTINCTA** var. nov. Plate 2, fig. 7.

Differs from the type in the presence of a long stria in the middle part of the valve between the central pores. Length, 0.052 mm; breadth, 0.0085. Striæ 9 in 0.01 mm. Rare.

GOMPHONEMA TROPICALE Brun. Plate 1, figs. 1 to 5; Plate 2, fig. 10.

Gomphonema tropicale Brun, A. SCHMIDT, Atlas Diatom. (1904) pl. 216, figs. 3, 4.

A distinct beautiful species, with lanceolate-clavate valves gradually tapering from the middle to the subacute ends. Median line filiform, with distinct terminal fissures and comma-shaped transverse fissures near the central pores. Axial area narrow, in the middle part dilated to an elliptic space, on one side of a transverse fascia 3 to 4 puncta. Common. Known only from Mekong River, India.

HANTZSCHIA AMPHIOXYS (Ehr.) Grunow.

Hantzschia amphioxys (Ehr.) Grunow, FR. HUSTEDT, Bacillar. (1930) 394, fig. 747.

Length, 0.057 mm; breadth, 0.0085. Keel puncta 7, striæ 22 in 0.01 mm. Rare.

NITZSCHIA ANGUSTATA (W. Smith) Grunow.

Nitzschia angustata (W. Smith) Grunow, FR. HUSTEDT, Bacillar. (1930) 402, fig. 767.

Length, 0.073 mm; breadth, 0.012. Striæ 12 to 13 in 0.01 mm. Rare.

NITZSCHIA LINEARIS W. Smith.

Nitzschia linearis W. Smith, FR. HUSTEDT, Bacillar. (1930) 409, fig. 784.

Length, 0.111 mm; breadth, 0.009. Keel puncta 10, striæ about 30 in 0.01 mm. Rare.

NITZSCHIA LINEARIS W. Smith var. TENUIS (W. Smith?) Grunow. Plate 4, fig. 6.

Nitzschia linearis W. Smith var. *tenuis* (W. Smith?) Grunow, VAN HEURCK, Synopsis (1880–81) pl. 67, fig. 16.

Length, 0.215 to 0.306 mm; breadth, 0.0085 to 0.01. Keel puncta 3 to 6, striæ 30 in 0.01 mm. Very common.

NITZSCHIA SUBVITREA Hust. var. MAXIMA var. nov. Plate 4, figs. 7 and 14.

Larger than the type. Length, 0.17 to 0.21 mm; breadth, 0.012 to 0.25. Keel puncta 4 to 6, striæ 28 to 30 in 0.01 mm. Very common. The type is reported from Central Asia.

NITZSCHIA DISSIPATA (Kütz.) Grunow.

Nitzschia dissipata (Kütz.) Grunow, FR. HUSTEDT, Bacillar. (1930) 412, fig. 789.

Length, 0.028 mm; breadth, 0.005. Keel puncta 7 to 8 in 0.01 mm. Uncommon.

NITZSCHIA FRUSTULUM (Kütz.) Grunow var. PERPUSILLA (Rabh.) Grunow.

Nitzschia frustulum (Kütz.) Grunow var. *perpusilla* (Rabh.) Grunow, VAN HEURCK, Synopsis (1880–81) pl. 99, fig. 6.

Length, 0.012 mm; breadth, 0.0025. Keel puncta 18, striæ 25 to 30 in 0.01 mm. Rare.

NITZSCHIA PALEA (Kütz.) W. Smith.

Nitzschia palea (Kütz.) W. Smith, FR. HUSTEDT, Bacillar. (1930) 416, fig. 801.

Length, 0.04 mm; breadth, 0.004. Keel puncta 17 in 0.01 mm. Striæ indistinct. Uncommon.

NITZSCHIA SIGMOIDEA (Ehr.) W. Smith.

Nitzschia sigmoidea (Ehr.) W. Smith, FR. HUSTEDT, Bacillar. (1930) 419, fig. 810.

Length, 0.25 mm; breadth, 0.013. Keel puncta 6 in 0.01 mm. Abundant.

NITZSCHIA ACICULARIS W. Smith.

Nitzschia acicularis W. Smith, FR. HUSTEDT, Bacillar. (1930) 423, fig. 821.

Length, 0.059 mm; breadth, 0.034. Keel puncta 15 in 0.01 mm. Striæ very fine, indistinct. Rare.

CYMATOPLEURA SOLEA (Breb.) W. Smith.

Cymatopleura solea (Breb.) W. Smith, FR. HUSTEDT, Bacillar. (1930) 425, fig. 823*a*.

Length, 0.127 mm; breadth, 0.024. Common.

CYMATOPLEURA SOLEA (Breb.) W. Smith var. REGULA (Ehr.) Grunow. Plate 3, fig. 3.

Cymatopleura solea (Breb.) W. Smith var. *regula* (Ehr.) Grunow, FR. HUSTEDT, Bacillar. (1930) 426, fig. 823.

Length, 0.076 to 0.153 mm; breadth, 0.013 to 0.028. Striæ 18 in 0.01 mm. Uncommon.

CYMATOPLEURA ELLIPTICA (Breb.) W. Smith.

Cymatopleura elliptica (Breb.) W. Smith, FR. HUSTEDT, Bacillar. (1930) 426, 427, fig. 825.

Length, 0.102 mm; breadth, 0.051. Very common.

SURIRELLA CAPRONII Breb.

Surirella Capronii Breb., FR. HUSTEDT, Bacillar. (1930) 440, fig. 857.

Length, 0.122; breadth, 0.051. Rare.

SURIRELLA LINEARIS W. Smith. Plate 3, fig. 1.

Surirella linearis W. Smith, FR. HUSTEDT, Bacillar. (1930) 434, figs. 837, 838.

Length, 0.088 mm; breadth, 0.025. Costæ 2.5 in 0.01 mm. Infrequent.

SURIRELLA LINEARIS W. Smith var. HELVETICA (Brun) Meister. Plate 3, fig. 2.

Surirella linearis W. Smith var. *helvetica* (Brun) Meister, FR. HUSTEDT, Bacillar. (1930) 434, fig. 840.

Length, 0.102 mm; breadth, 0.025. Rare.

SURIRELLA LINEARIS W. Smith var. CONSTRICTA (Ehr.) Grunow. Plate 3, fig 4.

Surirella linearis W. Smith var. *constricta* (Ehr.) Grunow, FR. HUSTEDT, Bacillar. (1930) 434, fig. 839.

Length, 0.068 mm; breadth, 0.013. Uncommon.

SURIRELLA LINEARIS W. Smith var. VERMIFERA var. nov. Plate 4, fig. 19.

Valve linear-elliptic, with distinct central area covered with irregular spines. Length, 0.051 mm; breadth, 0.013. Rare.

SURIRELLA SPIRALIS Kützing. Plate 3, fig. 19.

Surirella spiralis Kützing, FR. HUSTEDT, Bacillar. (1930) 445, 446, fig. 870.

Length, 0.15 mm; breadth, 0.059. Rare.

SURIRELLA OVATA Kütz. var. PINNATA (W. Smith) Hustedt.

Surirella ovata Kütz. var. *pinnata* (W. Smith), FR. HUSTEDT, Bacillar. (1930) 442, fig. 865.

Length, 0.042 mm; breadth, 0.012. Rare.

SURIRELLA BENGALENSIS Grunow. Plate 3, fig. 20.

Surirella bengalensis Grunow, A. SCHMIDT, Atlas Diatom. (1875) pl. 24, fig. 16; FR. MEISTER, Beiträge zur Bacillar. Japans 2 (1914) 229, pl. 8, figs. 11–13.

Valve broad-ovate, with distinct broad outer rim and costæ not reaching the pseudoraphe. Marginal keel forming wings. Length, 0.078 mm; breadth, 0.042. Rare. Known from Bengal, India, and Tokyo, Nippon.

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ILLUSTRATIONS

PLATE 1

FIGS. 1 to 5. *Gomphonema tropicale* Brun.
FIG. 6. *Gomphonema longiceps* Ehr. var. *subclavata* Grun.
7. *Cymbella sinica* sp. nov.
8. *Gomphonema tergestinum* (Grun.) Fricke.
9. *Gomphonema longiceps* Ehr. var. *subclavata* Grun.
10. *Gomphonema Kaznakowi* Meresch.
11. *Gomphonema longiceps* Ehr. var. *subclavata* Grun.
12. *Gomphonema lanceolatum* Ehr.
13. *Cymbella tumidula* Grun. fo. *recta* fo. nov.
14. *Gomphonema Kaznakowi* Meresch.

PLATE 2

FIGS. 1 and 2. *Gomphonema Kaznakowi* Meresch.
FIG. 3. *Didymosphenia geminata* (Lyng.) M. Sch.
4. *Actinocyclus Ehrenbergii* Ralfs var. *crassa* (W. Smith) Hustedt.
5. *Cymbella rupicola* Grun.
6. *Cymbella sinica* sp. nov.
7. *Gomphonema Kaznakowi* Meresch. var. *distincta* var. nov.
FIGS. 8 and 9. *Cymbella Stuxbergii* Cleve var. *tumida* var. nov.
FIG. 10. *Gomphonema tropicale* Brun.
11. *Diploneis Bombus* Ehr. var. *egena* A. S.
12. *Cymbella tumida* (Breb.) Van Heurck.
13. *Gomphonema intricatum* Kütz.
14. *Navicula cryptocephala* Kütz. var. *exilis* Kütz. forma.
FIGS. 15 and 16. *Navicula peregrina* (Ehr.) Kütz. var. *sinica* var. nov.

PLATE 3

FIG. 1. *Surirella linearis* W. Smith.
2. *Surirella linearis* W. Smith var. *helvetica* (Brun) Meister.
3. *Cymatopleura solea* (Breb.) W. Smith var. *regula* (Ehr.) Grun.
4. *Surirella linearis* W. Smith var. *constricta* (Ehr.) Grun.
FIGS. 5 and 6. *Achnanthes sublinearis* sp. nov. var. *complexa* var. nov.
FIG. 7. *Achnanthes affinis* Grun. var. *bistriata* var. nov.
FIGS. 8 and 9. *Diatoma anceps* (Ehr.) Grun.
FIG. 10. *Diatoma vulgare* Bory var. *ovalis* (Fricke) Hust.
FIGS. 11 to 14. *Achnanthes sublinearis* sp. nov.
FIG. 15. *Diatoma vulgare* Bory.
16. *Cymbella hybrida* Grun.
FIGS. 17 and 18. *Achnanthes pinnata* Hust.
FIG. 19. *Surirella spiralis* Kütz.
20. *Surirella bengalensis* Grun.
21. *Cymbella semicircularis* Lagerst.

FIG. 22. *Achnanthes sublinearis* sp. nov. var. *complexa* var. nov.
23. *Achnanthes sublinearis* sp. nov. var. *elliptica* var. nov.
24. *Navicula rhynchosephala* Kütz. var. *tenua* var. nov.
FIGS. 25 to 27. *Synedra ulna* (Nitz.) Ehr. var. *tenuirostris* var. nov.
FIG. 28. *Achnanthes sublinearis* sp. nov.
29. *Synedra ulna* (Nitz.) Ehr. var. *tenuirostris* var. nov.

PLATE 4

FIGS. 1 to 4. *Synedra Vaucheriae* Kütz.
FIG. 5. *Navicula salinarum* Grun. forma.
6. *Nitzschia linearis* W. Smith var. *tenuis* (W. Smith.?) Grun.
7. *Nitzschia subvitrea* Hust. var. *maxima* var. nov.
8. *Gyrosigma attenuatum* (Kütz.) Rabh. var. *asiatica* var. nov.
9. *Amphora mongolica* Oestr.
10. *Synedra ulna* (Nitz.) Ehr. var. *lanceolata* Kütz. fo. *constricta* fo. nov.
11. *Synedra Vaucheriae* Kütz. var. *capitata* var. nov.
12. *Gomphonema Heideni* Hust. var. *sinica* var. nov.
13. *Navicula rhynchocephala* Kütz. var. *tenua* var. nov.
14. *Nitzschia subvitrea* Hust. var. *maxima* var. nov.
15. *Cymbella tumida* (Breb.) Van Heurck.
16. *Gomphonema intricatum* Kütz.
17. *Cymbella sinica* sp. nov.
18. *Amphora ovalis* Kütz. var. *libyca* (Ehr.) Cleve.
19. *Surirella linearis* W. Smith var. *vermifera* var. nov.
20. *Caloneis patagonica* Cleve var. *sinica* var. nov.
21. *Navicula pusio* Cleve.
22. *Navicula peregrina* (Ehr.) Kütz.

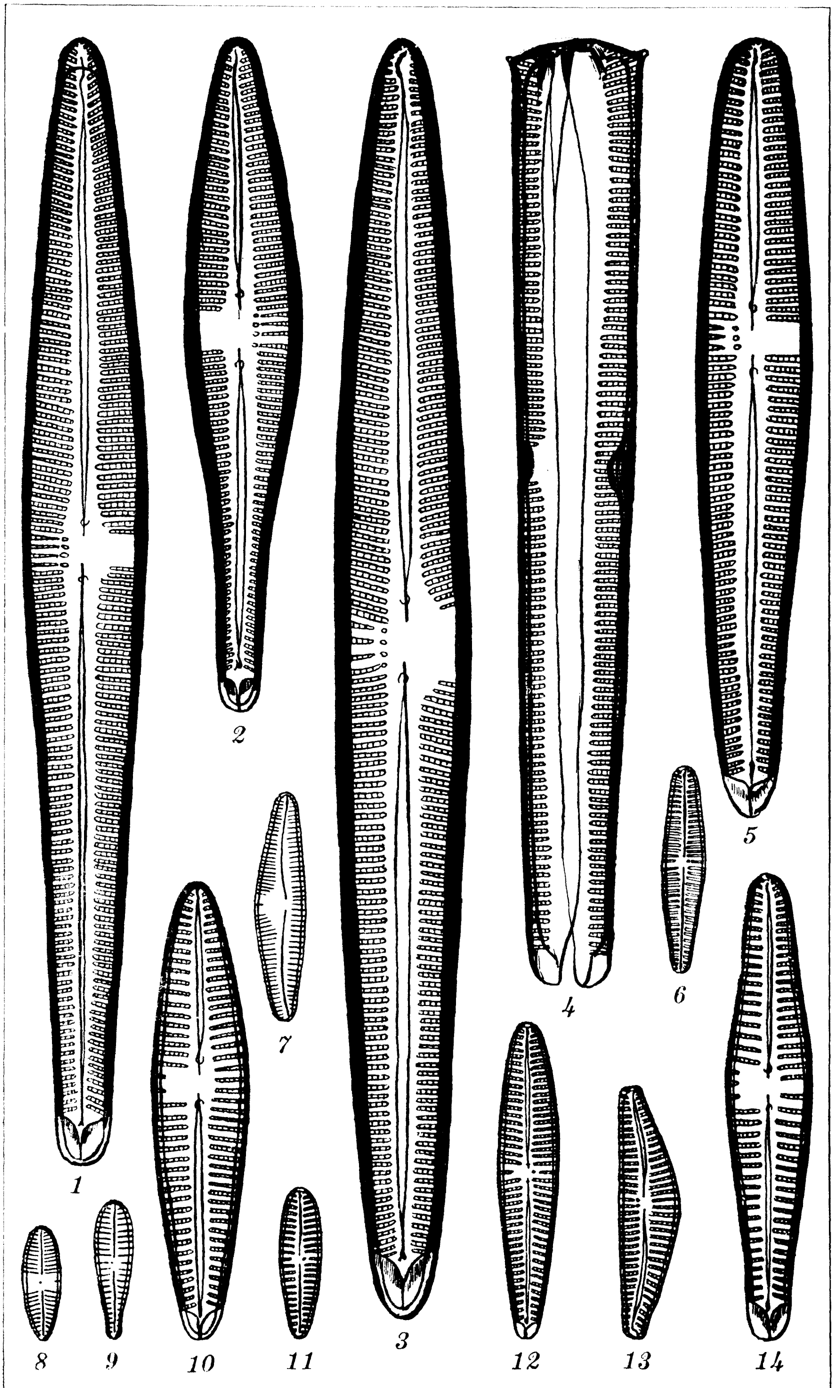

PLATE 1.

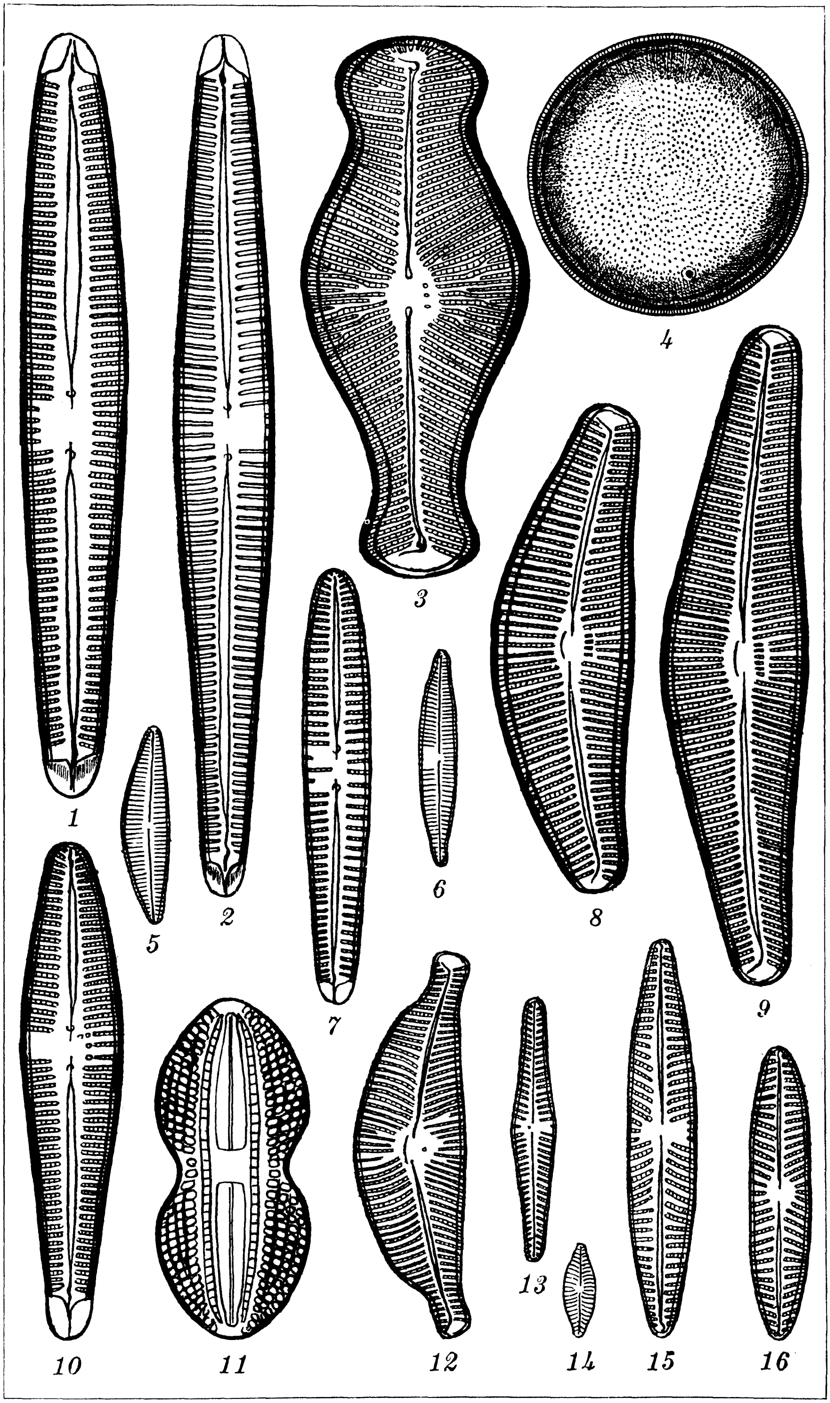

PLATE 2.

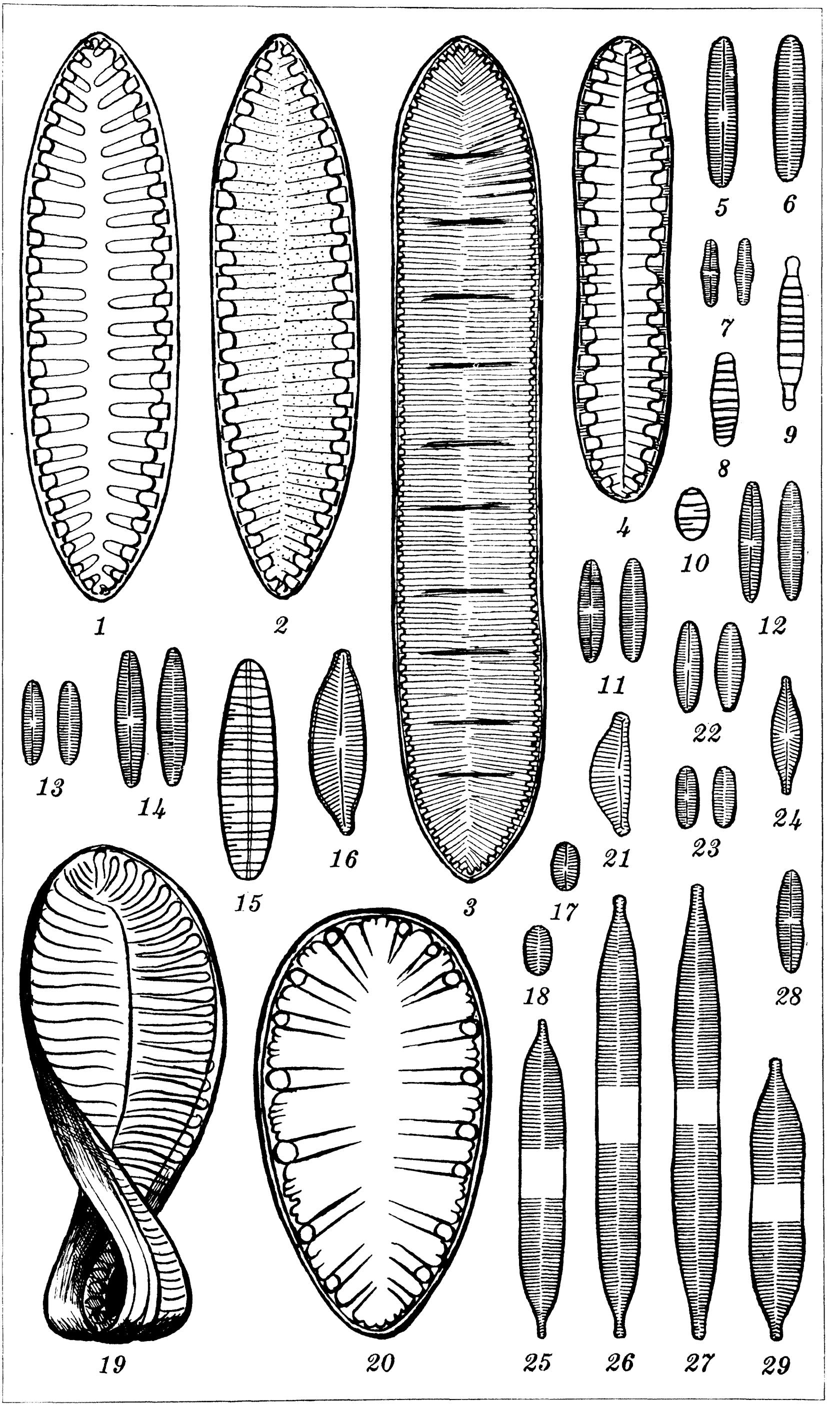

PLATE 3.

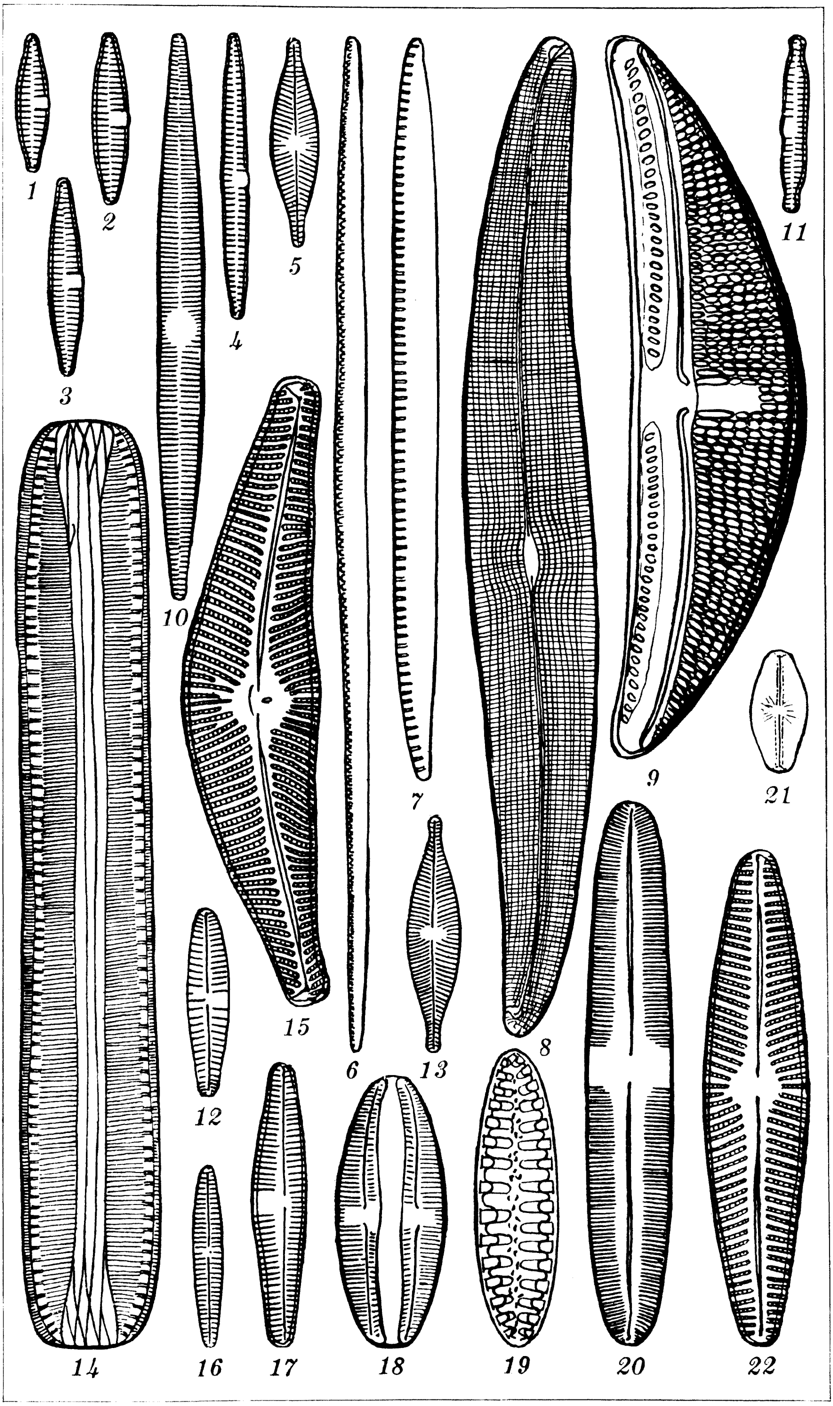

PLATE 4.

TWO SPECIES OF PINNA APPARENTLY NEW TO THE PHILIPPINES

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ONE PLATE

The genus *Pinna* [local names, *tambulog* (Tag.), *taló* (Cebu Vis.), and *tarab* (Negros Vis.)] is widely represented by a number of species in the warm seas, nineteen of which have been reported from the Philippines. It is characterized by similar oblique, thin, fragile, wedge-shaped, and generally scaled valves; lateral hinge without teeth, umbones terminal, anterior, with ligament in a groove, the mantle, a double-fringed footlike process, extends beyond the shell margin.

The species of *Pinna* are found attached to solid objects by means of strong byssi, or buried in sandy-muddy bottom with the ventral margins slightly gaping at the surface.

PINNA INCURVATA Chemnitz. Plate 1, fig. 1.

Pinna incurvata Chemnitz, REEVE, Conchol. Icon. 11 (1859) *Pinna*, pl. 5, fig. 8.

Shell slender, lanceolately fan-shaped, anterior abruptly notched, keeled at the middle with sides gradually sloping, smooth, livid ash, sprayed with a slightly bluish tint; anterior obliquely wrinkled, posterior very finely rugose.

NEGROS, Pontevedra, Bur. Sci. 14851, *Ablan*.

The unique specimen tallies in many respects with the one described by Reeve, differing only in having the anterior side abruptly notched, a variation that does not warrant placing it under a new name, especially since it may be due partly to adverse living conditions.

PINNA JAPONICA Hanley. Plate 1, fig. 2.

Pinna japonica Hanley, REEVE, Conchol. Icon. 11 (1859) *Pinna*, pl. 25, fig. 47.

Shell triangularly fan-shaped, thin, olive ash, anterior side produced, concentrically finely striated, posterior side rather incurved, radiately ridged, ridges irregular, margins sparsely scaled near umbones.

NEGROS, Pontevedra, Bur. Sci. 14852, *Ablan*.

This species resembles closely *Pinna hanleyi* and may easily be taken for the young of the latter.

ILLUSTRATION

PLATE 1

FIG. 1. *Pinna incurvata* Chemnitz.
2. *Pinna japonica* Hanley.

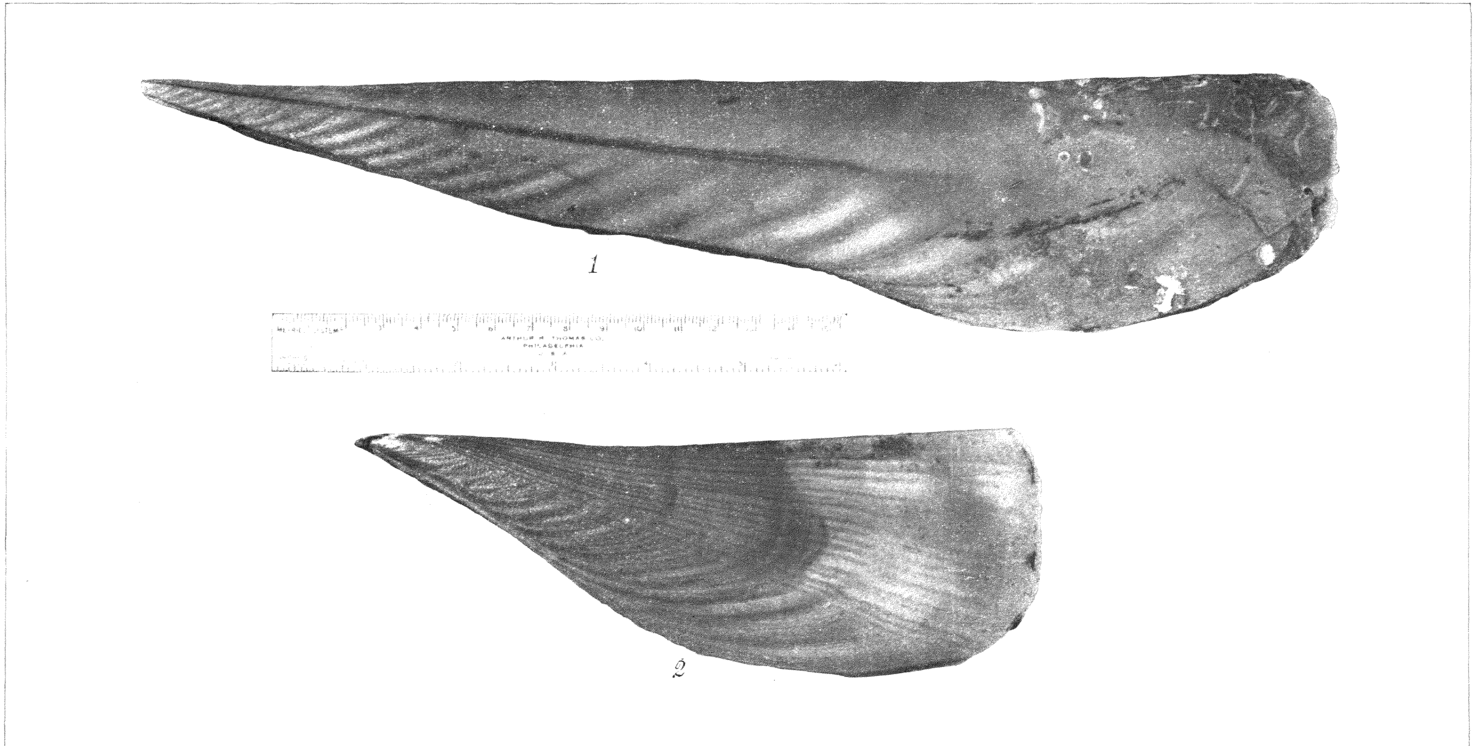

Fig. 1. Pinna incurvata Chemnitz; 2. Pinna japonica Hanley.

PLATE 1.

FISHERIES OF NORTHEASTERN LUZON AND THE BABUYAN AND BATANES ISLANDS

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FIVE PLATES

A preliminary survey of the fishery industries of northeastern Luzon, the Babuyan Group, and the Batanes Islands was started in May, and continued up to December, 1937, covering a period of eight months of extension work, observation, and study of the seasonal occurrence of various species of food fishes and other fishery products. This study was made in accordance wtih the provisions of the Bureau of Science Memorandum Order No. 20, dated March 23, 1936, and Travel Order No. 351, dated May 12, 1937.

In this paper are discussed the important fishing grounds, their fishery resources, the methods of exploitation, and fish preservation. Suggestions are made for the improvement of the fishing industry.

IMPORTANT FISHERIES OF CAGAYAN PROVINCE

Cagayan Province is a progressive province of the Cagayan Valley, in northeastern Luzon. It is drained by the Cagayan River, the largest navigable river system of Luzon. Next to agriculture, fishing is the most important industry of Cagayan Province. According to estimates not less than 200,000 pesos are invested in fishing boats, chinchorros, fish corrals, and other gear used in this industry. The taxes derived from these fisheries amount to 8,000 pesos annually.

Cagayan Province offers various fishery resources. The seasonal occurrence of important fisheries follows: (*a*) the *aramang* or shrimp fisheries, from August to January; (*b*) the *lodong* or mullet fisheries, from October to November; (*c*) the *ipon* fisheries, from November to March; (*d*) the sea-catfish or *kurilao* fisheries, throughout the year; (*e*) the fresh-water catfish or *paltat* fisheries, during rainy season, from May to December; (*f*) the hairtail or *bolungnas* fisheries, from March to August; (*g*) the croaker or *tuel* fisheries, from March to

August; (*h*) the sardine and anchovy fisheries, from January to September; (*i*) the siganid fry or *padas* fisheries; (*j*) the molluskan or *cabibi* and *gacca* or bean-clam fisheries, from January to September; (*k*) the collection of the edible and medicinal seaweeds of northern Luzon, from January to April. Some of the major fisheries are described in this paper.

Fishing in Cagayan Province is carried on extensively along the marine shores, rivers, and tidal creeks. The methods used are varied, numerous, and primitive (Plates 1 to 3).

However, the most important fishing gear used in Cagayan Province are the *chinchorro* nets, *bannuar, tabac, tarik, pateng, bobó, taco, bantac,* and *sapiao* nets. Deep-sea fishing is practically unknown.

Chinchorro fishing in Cagayan Province is limited to nine months of the year, from January to September, because from September to February rough weather as well as heavy rains and occasional floods prevail. The minor fishing activities during this period are the catching of the ipon, lodong, and aramang.

Table 1 partially shows the quantity and value of fish (anchovies, sardines, spada, bilis, and others) caught with chinchorro outfits from January to September, 1937, at the fishing barrios of Gonzaga, Buguey, Aparri, and Ballesteros. A total of 6,299.8 *saludan,* 314,890 kilos, of fish were caught, valued at 38,284.92 pesos,[1] or a monthly average of 34,987.7 kilos valued at 4,256.10 pesos. The height of the fishing season in Cagayan Province is during May, when 2,347.5 saludan, 11,737.5 kilos, of fish were caught in 1937, valued at 14,256.30 pesos. At Puro San Vicente, Gonzaga, not less than 2,000 *tinajas,* or *burnay,* of bagoong, valued at 8,000 pesos, were made out of the catch of four sapiao nets from April to June, 1937.

The fishing localities of Cagayan Province covered in the survey are described in the following paragraphs.

Aparri.—Aparri, the principal port in northern Luzon, is located on the eastern side of the mouth of Cagayan River; it is a commercial center as well as a fishing town. There are rich fishing grounds for sardines (*aber*), hairtails (*spada*), anchovies (*monamon* or *bombra*), croakers (*tuel*), talakitoc, sea catfish (*kurilao*), mullets (*lodong, pasga*), crustaceans (*aramang, padao, pasayan, rasa*), and other species along the northern coast of this municipality.

[1] One peso equals 50 cents United States currency.

TABLE 1.—*Partially showing the quantity and value of fish caught with chinchorro in northern Cagayan Province from January to September, 1937.*

Month.	Number of saludan or canastros.	Price.
		Pesos.
January	48.5	148.95
February	443.0	2,030.63
March	668.8	4,133.22
April	1,521.0	9,418.97
May	2,347.5	14,256.30
June	609.5	3,924.80
July	220.5	1,323.18
August	252.0	1,627.14
September	189.0	1,441.73
Total	6,299.8	38,284.92

In Aparri there are 14 shore-fishing boats, 26 chinchorros for catching fish, and 100 small boats (*balasiang*) used in connection with *bannuar* nets for *aramang*, and *bantac* fishing for hairtails (*bolungnas*) and croakers (*tuel*). Aparri is the landing center of catch in northern Luzon.

Here salting and drying fish is carried on extensively. There are 26 bagoong plants. Approximately 25,000 *tinajas* of bagoong are made and exported annually to the interior towns of the Cagayan Valley and the Ilocos regions.

In 1935 the municipality derived an income of 2,228 pesos from fishing, and in 1936 the income from the fisheries was 2,121 pesos.

Buguey.—Buguey, a coastal town about 14 kilometers east of Aparri, is also a fishing town. There are 3 shore-fishing boats and 3 chinchorros for catching anchovies, sardines, hairtails, and other species. The most important gear employed in the tidal creeks is the tarik, a shallow fish corral of the *inangcla bannuar* style. About 120 tarik are operating in this municipality. The catch of the chinchorros and tarik is usually sold at Aparri, because there are no bagoong and drying plants in Buguey.

The municipality collected 2,892 pesos for fishery fees in 1935 and 3,164 pesos in 1936. The increase of the municipal income from the fisheries is due to a number of fishermen that have come from Aparri.

Gonzaga.—Gonzaga is an inland town about 11 kilometers east of Buguey, but it has a number of fishing barrios along its coast. The important fishing villages are those of Batangan,

Tangatan, Palawig, and Puro San Vicente Bay. Fishermen of these barrios are settlers from the fishing villages of Ilocos Norte and Ilocos Sur. Gonzaga is an important fishing town due to the introduction of 4 sapiao nets at Tangatan and Palawig. There are 27 shore-fishing boats and 27 chinchorros in all in these fishing barrios. The town being sparsely populated, its surplus of fishery products is exported to the Ilocos Provinces in the form of bagoong and dried fish, *dalangdang*.

At Palawig Islands of Gonzaga various fishery products are gathered; namely, rarang, trochus shells, sea turtles, and edible seaweeds the most important of which is *Digenea simplex*. The latter, which is a medicinal seaweed, was noted last June at Punta Verde. The income from the fisheries in 1935 was 495.50 pesos, and in 1936, 663.15 pesos.

Ballesteros.—Ballesteros is another coastal town about 9 kilometers northwest of Aparri. It is more of an agricultural town than a fishing center. There are only 3 fishing boats and 3 chinchorros. As there are only a few fishing villages in this town, its coast is often visited by fishermen from Aparri, because the municipality has good fishing grounds for sardines and anchovies. The catch in Ballesteros is sold at Aparri for local consumption and bagoong making. Fresh-water fisheries are limited to the rice ditches. Here paltat, dalag, and *araro* are caught.

The municipality had an income of 726.80 pesos in 1935 and 465.00 pesos in 1936.

Abulug.—Abulug is a town located on the eastern side of the Abulug river, which also drains Apayao. The fisheries of this municipality are not as important as those of Aparri and Buguey. There are only 3 fishing boats and several fish corrals.

In 1935 the municipality had an income of 576 pesos from its fisheries; in 1936 the income was 336 pesos.

Pamplona.—Pamplona, being an agricultural town west of Abulug, is drained by the Pamplona River. It is not an important fishing town. The fisheries are located at the fishing barrios of San Juan and Allappañgan. There are 3 fishing boats and chinchorros and several fish corrals. The income from the fisheries of this municipality in 1935 was 267 pesos; in 1936 the income from fishery fees amounted to 415 pesos.

Sanchez Mira.—The fisheries of Sanchez Mira are not important. The town is drained by the Masisiit River. There are only 4 shore-fishing boats and 3 chinchorros. The income

from the fisheries in 1935 was 245.35 pesos; in 1936 the income from fees amounted to 156.10 pesos.

Claveria.—Claveria, a coastal town on the northwestern part of Cagayan Province, is an agricultural as well as a fishing town. The town is drained by Cabicuñgan River. There are 11 shore-fishing boats and 11 chinchorros in this town. The small bay of Claveria is a fishing ground for sardines and anchovies. The income from the fisheries for 1935 was 370 pesos; in 1936 the fishery fees amounted to 342 pesos.

Table 2 shows the fees for fishery privileges collected in Cagayan Province in 1935 and 1936.

TABLE 2.—*Fees for fishery privileges in Cagayan Province.*

Municipality.	1935	1936
	Pesos.	*Pesos.*
Abulug	576.31	336.83
Aparri	2,228.45	2,121.55
Baggao	21.00	14.00
Ballesteros	726.80	465.60
Buguey	2,892.61	3,163.87
Calayan Island	68.25	61.75
Camalaniugan	50.50	65.60
Claveria	370.70	342.20
Gattaran	8.50	7.00
Gonzaga	495.50	663.15
Lal-lo	----------	6.00
Langangan	15.60	14.90
Pamplona	267.00	415.00
Peñablanca	40.00	38.00
Sanchez Mira	345.35	156.10
Tuguegarao	25.00	10.00
Total	8,131.37	7,881.55

Table 3 gives the names of fishes in Cagayan Province.

CRUSTACEAN FISHERIES

An important crustacean fishery of Cagayan is the aramang fishery. The aramang is a shrimp, belonging to the family Palæmonidæ. It is taken in large quantities at the mouth of Cagayan River and at marine shores during the rainy months from August to January. The gear used for catching shrimps is a small pelagic seine called bannuar (Plate 1, fig. 4; Plate 2, figs. 1 and 2). At Aparri about 100 small boats, balasiang, are used in the operation of the bannuar. An average catch of a bannuar is from 1 to 5 cavanes of aramang. The catch is usually dried along the beach or salted into bagoong. Dried aramang

TABLE 3.—*Fishes found in Cagayan Province.*

Iloko names.	English names.	Scientific name.
Aber	Herring, sardine	Clupeidæ.
Alimoking	Cæsio	*Cæsio* spp.
Aliso	Gray snapper	*Lutjanus* spp.
Arraro	Climbing perch	*Anabas testudineus* (Bloch).
Arraro-baybay	Coral fish	Pomacentridæ.
Awa	Milkfish	*Chanos chanos* Forskål.
Babayo, babayote	Barracuda	*Sphyræna aureoflammæ* Seale.
Bagabaga	Cardinal fish	*Amia* spp.
Bakilya	Roncador	*Umbrina* spp.
Balaki	Goat fish	Mullidæ.
Balagbagan	Hammerhead shark	*Sphyrna zygaena* (Linnæus).
Balbaliga	Silver-bar fish	*Chirocentrus dorab* (Forskål).
Bal-la	Goby	*Glossogobius giurus* Buch.-Ham.
Ballañgaoan	Hardtail	*Megalaspis cordyla* (Linnæus).
Banasak	Goby mud skipper	*Periophthalmus barbarus* (Linnæus).
Bañgos	Milkfish	*Chanos chanos* Forskål.
Barañgan	Siganid	*Amphacanthus virgatus* (C. and V.).
Baraoñgan	Grunt	*Therapon jarbua* Forskål.
Baraniti	Cæsio	*Cæsio caerulaureus* (Lacépède).
Barasot	Halfbeak	*Tylosurus giganteus* (Schlegel).
Bercacan	Painted moray	*Gymnothorax pictus* (Ahl.).
Begsang	Giass perch	*Ambassis* spp.
Bilis	Sardine	Clupeidæ.
Bitilla	Porgy	*Lethrinus atkinsoni* Seale.
Bolungnas	Cutlass fish	*Trichiurus haumela* (Forskål).
Bombra	Anchovy (adult)	*Anchovia commersoniana* Lacépède.
Borador	Flying fish	*Cypselurus oligolepis* (Bleeker).
Batobot	Goby	*Bunaka pinguis* Herre.
Bugui	Milkfish fry	*Chanos chanos* Forskål.
Bukto	Goby	*Chonophorus melanocephalus* (Bleeker).
Bulanbulan	Tarpon	*Megalops cyprinoides* (Brouss.).
Bunog	Goby	*Chonophorus ocellaries* (Brouss.).
Cadis	Spotted moonfish	*Mene maculata* (Bloch and Schneider).
Campa	Goby	*Rhyacichthys aspro* Kuhl and Van Hasselt.
Dadali	Flounder	*Psettodes erumei* (Bl. and Schn.).
Dalag	Murrel	*Ophicephalus striatus* Bloch.
Daldalag taaw	Lizard fish	*Saurida tumbil* (Bloch).
Garitan	Pampano	*Gnathandon speciosus* (Forskål).
Gumabek	Slipmouth	Leiognathidæ.
Igat	Eel, fresh-water	*Anguilla mauritiana* Bennett.
Ilec	Rudder fish	*Kyphosus cinerascens* Forskål.
Immaradu	Spotted guitar fish	*Rhynchobatus djiddensis* Forskål.
Ipon	Goby fry	Gobiidæ.
Iyo	Shark	Galeidæ.
Kabasi	Gizzard shad	*Anadontostoma chacunda* Buch.-Ham.
Kugao	Threadfin	*Polydactylus seali* (Jordan and Richardson).
Kulañgit	Yellow leatherjacket	*Scomberoides lysan* (Forskål).
Kurapu	Grouper	*Epinephelus megachir* Richardson.
Kurilao	Sea catfish	*Arius* spp.
Lapes	Mullet	*Mugil* spp.
Lapolapo	Grouper	*Epinephelus megachir* Richardson.
Layalay	Garfish	*Ablennes hians* (Cuv. and Val.).
Lodong	Mullet	*Mugil seheli* Forskål.
Lumitog	do	Mugilidæ.
Maiamaia	Snapper	*Lutjanus* spp.
Malaga	Kitang	*Scatophagus argus* Boddaert.

TABLE 3.—*Fishes found in Cagayan Province*—Continued.

Iloko names.	English names.	Scientific name.
Mamata	Anchovy	*Scutengraulis hamiltonii* (Gray).
Mataan	Chub mackerel	*Scomber microlepidotus.*
Monamon	Anchovy, small	*Anchovia commersoniana* Lacépède.
Mulmul	Parrot fish	Labridæ.
Osoos	Whiting	*Sillago sihama* Forskål.
Padas	Siganid fry	Amphacantidæ.
Paliling	Goby	*Sicyopterus lacrymosus* Herre.
Palo	Conger eel	*Leptocephalidæ.*
Paltat	Catfish	*Clarias batrachus* Linnæus.
Porong	Mullet	*Mugil* spp.
Quioet	Eel	*Anguilla mauritiana* Bennett.
Qurarato	Silver piko eel	*Muræsenox cinereus* (Forskål).
Sapsap	Slipmouth	*Leiognathus caballus* (Cuv. and Val.).
Seckeran	Pampano	*Caranx auriga* Seale.
Siriw	Bill fish	*Tylosurus* spp.
Sisiao	Grunt	*Therapon plumbeus* Kner.
Talakitok	Cavalla	*Caranx* spp.
Talibucno	Slipmouth	Leiognathidæ.
Tamban	Sardine	*Sardinella moluccensis* Bleeker.
Do	Herring	*Dussumieria* spp.
Do	Herring, round-bodied	*Sardinella fimbriata* (Cuv. and Val.).
Do	Sardine	*Sardinella longiceps* (Cuv. and Val.).
Do	Herring, deep-bodied	*Sardinella perforata* (Cantor).
Tañĝuigui	Spanish mackerel	*Cybium commersoni* Lacépède.
Tariptip	Slipmouth	Leiognathidæ.
Ti-i	Silverside	*Atherina forskalii* Ruppell.
Tuel	Croaker	Sciænidæ.
Tuñĝi	Albacore	Thunnidæ.
Usub	Slipmouth	Leiognathidæ.
Virot	Eleotrid	*Eleotris melanosoma* Bleeker.

is packed in boxes or sacks and shipped to Manila and the Ilocos regions, mostly by Chinese, and by a few Filipino dealers. From September to December, 1937, 62 boxes, or 720 sacks, of aramang were shipped to the Ilocos, and 64 sacks of dried aramang were sent to Manila. A sack of dried aramang sells at from 2 to 5 pesos, and a *tinaja* of salted aramang sells at from 25 to 50 centavos. The aramang fishery of Cagayan Province is valued at 10,000 to 15,000 pesos annually.

Bagoong aramang is made into *patis,* while dried aramang is used for egg omelets or simply eaten with sliced tomatoes.

The larger species of the genus *Penæus,* namely, *P. monodon, P. affinis, P. semiculcatus, P. indicus,* and *P. incisipes,* are caught usually in the fish corrals of Buguey, and with tangar nets throughout the year. Crabs are caught with *tellem* at Aparri, Buguey, Linao, and Abulug.

LODONG FISHERIES

The lodong, or mullet, fishery of Cagayan Province is another seasonal fishery, carried on during November and December, the period when this species of mullet (*Mugil seheli* Forskål), migrates downstream, down Cagayan and Abulug Rivers, to spawn in the sea.

At present there are no records of the life history of the lodong. The tributaries of Cagayan River have been noted as the feeding grounds of lodong. No one knows the age at which the adult finds his way to the sea, but there is always a downstream migration of sexually mature lodong in November and December, just after a heavy rainful at night when the rivers are flooded. During this periodic "run" these fish are caught at the mouth of Cagayan and Abulug Rivers with various mullet gear; namely, pateng, tabocol, sakag, and tabac nets. After the flood the spawners that have escaped these devices migrate upstream. During this upward migration the lodong are caught by other devices, such as *teg* and *taquit* (dip nets).

The pateng (Plate 3, figs. 1 and 2) is a cylindrical fish basket made of bamboo splints and rattan. The bobo is 4.5 feet high and 3.5 feet in diameter. It has a funnel about 2.5 feet high and 1 foot in diameter. The closed end of the cylinder has a cable line of ratan about 15 meters long, with an anchor at end. During operation of the gear the anchor is dropped at the edge of the river bank and the pateng is left to drift in the water. When a school of mullet migrate down with the current the fish are led into the funnel of the pateng, because the pateng acts as a suction apparatus. The mullets that get in can never find their way out. A pateng usually catches from 1 to 25 adult lodong.

IPON FISHERIES

In Cagayan Province the catching of ipon is also a seasonal industry, carried on from November to March. Ipon fishing is carried on at Cabicungan River of Claveria; Abulug River, which drains the interior of Apayao; Cagayan River, the longest river system of Luzon, draining the Cagayan valley; and along the marine shores of Claveria, Aparri, and Buguey.

The ipon are fry of Eleotridæ and Gobiidæ. The gobies (Gobiidæ) are a large group of small carnivorous bottom fishes living along shores, bays, rivers, lakes, streams, swamps, and coral reefs. They feed on algæ, mollusks, crustaceans, and worms. Gobies are generally of a dull plain color, often indis-

tinguishable from their surroundings because they have the power of mimicry. Those that live along rocky shores and coral reefs are generally of a brilliant color. The following species are reported to be the sources of ipon: *Chonophorous melanocephalus* Bleeker (*bukto*, Ilk.); *Chonophorus ocellaries* Broussonet (*bunog*, Ilk.); *Eleotris melanosoma* Bleeker (*virot*, Ilk.); *Glossogobius giurus* (Buchanan-Hamilton) (*balla*, Ilk.); *Glossogobius celebius* (Cuvier and Valenciennes) (*balla*, Ilk.); *Ophiocara aporos* Bleeker (*dulong*, Ilk.); *Rhyacichthys aspro* (Kuhl & Van Hasselt) (*campa*, Ilk.); *Sicyopterus lacrymosus* Herre (*paliling*, Ilk.).

The adults of the ipon migrate seaward periodically to spawn during the period from June to November.

The ipon fishery starts as soon as the goby fry make their appearance with the incoming high tide, seven to nine days after the full moon of each month from November to March. Catching ipon with scissor nets and chinchorros along the coast and at river mouths lasts from one to four days, while catching them with barricade traps of bobos upstream may last for a week.

The ipon is considered a delicacy by the people of northern Luzon. The catch is usually sold fresh in the local markets or salted and sold in the form of bagoong. Ipon can be prepared for food in several ways, such as *kilawen*, *tamales*, and *sinigang*.

MOLLUSK FISHERIES

Along the sandy bottoms of Cagayan River at the barrios of Catayuan and Santa Maria of the municipality of Lallo, a species of fresh-water mussel, locally known as *cabibi*, *Corbicula fluminea* Müller, is present in large numbers. It is collected by means of a triangular dredging sieve (taco, Plate 2, fig. 3) made of bamboo splints, iron wire, rattan, and wood. A small boat (balasiang), is needed in the operation of the taco. No less than 75 taco fishermen gather cabibi in those two barrios during its season, from January to September.

The cabibi, which are sold fresh at Aparri, are extensively used as food, and can be prepared for the table by boiling together with tomatoes and salt. The fresh cabibi are also shucked and the raw meat prepared into bagoong, in the proportion of one part salt and two parts cabibi. In the markets fresh cabibi are sold at from 20 to 30 centavos a ganta. The empty shells are used in the manufacture of buyo lime. Two species of marine mollusks, namely, *gacca*, *Donax radians* Deshayes, and *onnok*,

Soletellina psammotæ minor Deshayes, are also gathered with a small dredge sieve, (taco, Plate 3, figs. 3 and 4) along the marine shores of Aparri, Buguey, Sanchez Mira, Ballesteros, and Abulug, from February to April. Gacca is salted in the whole and exported to the Ilocos regions. Onnok is prepared for the table simply by boiling with tomatoes and salt.

At the tidal creeks of Buguey and Abulug native oysters, *tirem* (*Ostrea* spp.), are gathered from the posts of the fish corrals and at the stems of nipa palms. Along the coral-reef regions edible mollusks of minor importance, such as *kir-kiraud* (*Circe gibba* Lamarck and *Circe pectinata* Linnæus), *siñgitan* (*Arca antiquata* Linnæus), *bibigan* (*Potamides terebralia sulcatus* Born), *barongbarong* (*Potamides telescopium* Linnæus) and *anduquil* (*Pharella acutidens* Broderip Sowerby) are gathered for food. At Puro San Vicente and Cape Engaño two commercial shells known as *rarang* (*Turbo marmoratus* Linnæus) and trocha or simong shells (*Trocus maximus* Koch) are gathered by the Aetas in small quantities. In the fresh waters there are species of edible shells, namely, *bisocol* (*Ampullaria luzonica* Reeve) and *leddeg* (*Vivipara angularis* Müller).

Cephalopods, namely, *korita* (*Octupus* spp.), *laki* (*Loligo* spp.), and *puspusit* (*Sepia* spp.) are also gathered by the Aetas with spear guns along the coral reefs of northern Cagayan Province. The edible and commercial mollusks and cephalopods caught in the waters of Cagayan Province are listed in Table 4.

TABLE 4.—*Edible and commercial mollusks of Cagayan Province.*

MOLLUSKS

Scientific name.	Iloko name.
Corbicula fluminea Müller	Cabibi
Cyrena ventricosa Deshayes	Kaggo
Donax radians Lamarck	Gacca
Soletellina (*Soletellina*) *cumingiana* Deshayes	Balingasa
Soletellina (*Psammotæa*) *minor* Deshayes	Onnok
Mytilus smaragdinus Chemnitz	Badong-badong
Pharella acutidens Broderip Sowerby	Anduquil
Anatina truncata Lamarck	Loslosi
Paphia hiantina Lamarck	Okian
Paphia strata Chemnitz	Do.
Circe gibba Lamarck	Kirkiraud
Circe pectinada Linnæus	Do.
Arca antiquata Linnæus	Siñgitan
Potamides (*terebralia*) *sulcatus* Born	Baronbarong
Potamides (*telescopium*) *telescopium* Linnæus	Bibigan
Ampullaria luzonica Reeve	Bisocol
Vivipara angularis Müller	Leddeg
Turbo marmoratus Linnæus	Rarang
Trochus maximus Koch	Trocha or simong

TABLE 4.—*Edible and commercial mollusks, etc.*—Continued.

CEPHALOPODS

Scientific name.	Iloko name.
Octupus spp.	Korita
Sepia spp.	Laki
Loligo spp.	Puspusit

SIGANID-FRY FISHERIES

The members of the family Amphacanthidæ are small to moderate-sized fishes reaching a maximum length of 40 centimeters. They are herbivorous, living among submerged coral reefs. Some are brilliant or dull in color. As a group they are excellent sources of protein food. The fry are caught and made into bagoong, or into *guinamos*, a delicacy among the people of northern Luzon.

The fry of the species of the genus *Amphacanthus*, of the family Amphacanthidæ, are known as *padas* (Pang., Ilk.); *yomoyobyob* (Ilk.); *kuing* (Bicol); and *kuyug* (Vis.). The adult siganids are known as *barañgan, malaga* (Ilk.); *batawayi, turus* (Bicol); *danguit, layap, mandalada, tayog* (Vis.); *belony, indogan* (Tao Sug. and Samal); and *samaral* (Tag.).

The siganids are found on the coral reefs of Claveria, Buguey, Puro San Vicente, and Gonzaga, Cagayan Province.

The species of siganids found in the above places are *Amphacanthus sutor* Cuv. and Val., *A. hexagonatus* (Bleeker), *A. doliatus* Cuvier, *A. virgatus* Cuv. & Val., and *A. oramin* Bloch and Schneider.

There are three distinct methods of catching the fry and adult siganids; namely, the *kammag,* or *tangar,* a small chinchorro net, the saquiao, or *sigay,* a drift gill net, and the spear gun.

The siganids do not constitute a regular fishery, most likely due to the lack of regulations to protect the source of the fry. The fishing season of the padas lasts through August and September and from March to May. The fishing of adult siganids lasts throughout the year. The practice of catching the breeding siganids and the fry with spear guns, drift gill nets, and tangar or kammag nets, are the possible causes of the depletion of the siganid fishery. Padas fry may appear in one year and not in the next two years. This periodic, unstable, condition of the siganid fishery is a hardship for the fishermen of northwestern Luzon. There are no adequate records of the catch of siganids, although the scarcity of the siganids and the absence of padas for the period 1935–1936 may constitute an indication of the serious depletion of the siganid fishery of northeastern Luzon.

EDIBLE AND MEDICINAL SEAWEEDS

On the coastal regions of northeastern and northern Luzon and the Babuyan Islands from January to April, are found seaweeds of economic value. However, the gathering of these seaweeds is still a minor industry. The people in these parts of the Philippines are very fond of eating seaweeds. They make salads, pickle, and soup from seaweeds, and they have learned to use a simple process of sun-drying them for future use. However, seaweeds are never gathered on a commercial scale. Whatever is sold on the market is obtained in small quantities by people living along the shores. Our fishermen have not seen the necessity of cultivating the seaweeds, because they are not interested in this minor product of the sea. It is not generally known that a number of chemical products, like soda, chloride, sulphate, iodine, bromine, santonin, and agar-agar are obtained from seaweeds. The seaweeds are utilized not only as an article of diet but in many places also for animal feed and fertilizer. Seaweeds contain large amounts of carbohydrates, small amounts of protein and fats, in addition to ashes, like sodium and potassium chlorides. Seaweeds are a source of iodine, which is recommended for the prevention of goiter.

The seaweed industry is important in many places, like Japan, the United States, Ireland, Scotland, Hawaii, France, and China. Japan alone has an annual income of from two to three million dollars from seaweeds.

The known commercial seaweeds found along the coastal regions of Cagayan Province, and the Babuyan Islands, are listed in Table 5.

TABLE 5.—*Commercial seaweeds found along the coasts of northern Luzon and the Babuyan Islands.*

Scientific name.	Iloko name.
Acanthopora orientalis	Culot
Fucus gulaman	Gulaman
Caulerpa sertularioides	Salsalamagui
Caulerpa freycinetti	Galgalacgac
Caulerpa racemosa var. *uvifera*	Ararusip
Chaetomorpha sp.	Riprippiis
Chaetomorpha crassa Kütz.	Cawatcawat
Codium tenue Kütz.	Pukpuklo
Digenea simplex (Wulf) C. Ag.	Bodobodo
Enteromorpha intestinalis (Linn.)	Lumut
Eucheuma spinosum (Linn.)	Ruprupppuuc
Gracilaria confervoides (Linn.)	Guraman

TABLE 5.—*Commercial seaweeds found, etc.*—Continued.

Scientific name.	Iloko name.
Gracilaria crassa Harv.	Susueldotbaby
Gracilaria eucheumoides Harv.	Canotcanot
Gracilaria lichenoides (Linn.)	Gargararao
Halymenia formosa Harv.	Gamet
Hydroclathrus cancellatus	Balbalulang
Hypnea sp.	Culot
Hypnea sp.	Guraman
Ligora cheyneana Harv.	Barisbaris
Sargasum siliquosum J. Ag.	Aragan

METHODS OF FISH PRESERVATION

The local market is very limited, considering the enormous catch of the fishermen of Aparri, Buguey, Gonzaga, and Ballesteros from January to September, so that surplus fish are either salted into bagoong or salted and sun-dried. The bagoong industry of Cagayan Province is centered at Aparri, the principal landing point of the catch from the nearby towns. There are 26 bagoong plants, which turn out from 25,000 to 30,000 earthern jars (tinajas) of bagoong, worth from 100,000 to 120,000 pesos annually.

Bagoong making.—The chinchorro or *daclis* outfits of Buguey, Aparri, and Ballesteros supply the bagoong manufacturers with the raw fish, mostly anchovies (*mamata, monamon, bombra*), sardines (*aber, bilis*), and *ganot-ganot,* a mixture of small fishes. The *daclisan* usually bring in their catch in the afternoon. From their boats (*viray*) the fish are placed in bamboo baskets (canastros or saludan). The bagoong manufacturers buy the fish, and the crew of the fishing boats deliver the canastros of fish to the bagoong plants. In the salting sheds the fish are salted in elevated holds of worn-out bancas. The proportion is one sack of salt to two saludan of fish, or one part of salt to two parts fish. The fish and salt are mixed thoroughly with wooden paddles or scoops.

The salted fish is then placed in earthern jars (burnay or tinaja). These earthern jars of salted fish are left uncovered for from 2 to 4 weeks for curing. After that period fly maggots are removed from the surface of the bagoong and the latter is covered with a clean cloth and leaves of nipa palms.

The cost of producing one burnay or tinaja of bagoong is as follows:

Item.	Pesos.
Raw fish	1.50
Salt	.30
Burnay (jar)	.50
Labor	.10
Freight	.50
Total	2.90

Drying.—The catches of the bantac fisherman, the fish corrals, and the native fishing nets are sold to the *dalangdang* dealers. The species selected for drying purposes are hairtails (bolungnas or spada); croakers (*tuel balat, tuel rongaab, tuel n̄girn̄gir,* and *tambor*); sea catfish (kurilao or kanduli); fresh-water catfish (paltat or *hito*); mullet (*lodong*); anchovies (monamon or bombra); sardines (bilis, aber); and shrimps (aramang).

The fish selected for dalangdang are brought to the working shed where they are sorted according to size. Then they are dressed (split on the back, and the gills and intestines removed), and cured in a solution of strong brine for from 2 to 4 hours, depending upon their size, species, and bulk. When they are moved from the curing jars and washed with fresh water or sea water, they are spread to dry on elevated platforms of split bamboo, where they are allowed to dry from 3 to 4 days.

The cost of drying bolungnas or tuel is as follows:

Item.	Pesos.
100 good-sized raw fish, hairtails (bolun̄gnas)	6.00
Salt	.20
Labor	.40
Total	6.60
100 good-sized croakers (tambor)	8.00
Salt	.20
Labor	.30
Total	8.50
100 good medium-sized raw fish, croakers	1.50
Salt	.10
Labor	.30
Total	1.90

THE FISHERIES OF THE BABUYAN ISLANDS

The Babuyan Islands, which are included in Cagayan Province, are the small islands (Babuyan, Panuitan, Calayan, Dalupirit, Fuga, and Camiguin), lying north of the channel along the northern coast of Luzon and south of the Balintang Channel.

The most important of the group is Calayan, where the town of Calayan is located.

The fisheries of the Babuyan Islands are not very significant, because they are not thickly inhabited. People there are more interested in logging and raising cattle for export. Game fishes, like mackerel, barracudas, talakitok, bonitos, and tunas, are abundant in these regions, which have often been visited by Japanese fishermen. Coral reefs and rocky shoals make up this group of islands. The fishes that are found in the coral reefs are cæsios or *dalagang bukid,* surgeon fishes or *labahitas,* bigeyes, porgies, red snappers or *maiamaia,* rudder fish or *ilec,* siganids or barañgan, and samaral.

Turbo shells are gathered in small quantities by the natives. Hawk-bill and logger-head turtles are also gathered at Panuitan Islands.

Dalupiri Island is noted for its medicinal seaweed, *Digenea simplex,* which was discovered by Dr. H. H. Bartlett, then an exchange professor from the University of Michigan to the University of the Philippines. Doctor Bartlett believes that if this seaweed is gathered, conservatively the reef at "Visita" of Dalupiri can provide an abundant supply, and the industry would be a source of supplementary income for the people of Dalupiri Island.

Calayan Island had an income from fisheries of 68.20 pesos in 1935 and 61.75 pesos in 1936.

THE FISHERIES OF ISABELA PROVINCE

Isabela Province is also drained by Cagayan River, the largest river system of northern Luzon, and Palanan River on the eastern side of the province. There are two minor bays on the eastern side; namely, Divilican Bay and Palanan Bay.

The towns bordering Cagayan River and its tributaries that have minor fisheries are Cabagan, Ilagan, San Mariano, Naguilian, Angadanan, Echague, Jones, and Santiago. Palanan is a town 8 kilometers from the mouth of Palanan River.

The fresh-water fishes of Isabela are dalag, paltat, araro, various species of gobies, lodong, *sisiao,* kurilao, fresh-water shrimps, and crabs.

The gear used for river fishing are the bobo, hook and line, the small chinchorro or tabac, the *kuileb* or *asar,* and the tabocol.

Palanan Bay on the eastern side of Isabela Province is semicircular in form, about 6 miles wide and 3 miles deep. Palanan River empties into the southern part of the bay.

The fisheries of Palanan Bay are not very important. There are no chinchorros in these waters. Fishermen from Bohol come to Palanan Bay yearly to gather hawks-bill turtles for tortoise shell, and trochus and turbo shells. Edible mollusks, such as *caraboyo, cappo,* and tirem, are abundant. Small quantities of seaweeds are gathered for food.

The income of Isabela Province from fisheries in 1935 was 471.10 pesos, and 506.38 pesos in 1936 (Table 6).

TABLE 6.—*Fees collected for fishery privileges in Isabela Province.*

Municipality.	1935	1936
	Pesos.	*Pesos.*
Angadanan	35.00	25.00
Cabagan	38.60	100.00
Echague	37.50	62.50
Ilagan	152.00	92.00
Jones	80.00	90.00
Naguilian	18.00	27.20
Palanan	----------	10.50
Reina Mercedes	50.00	60.00
San Mariano	50.00	26.68
Santiago	10.00	12.50
Total	471.10	506.38

The fish supply of Isabela Province comes from Aparri in the form of bagoong, dried fish, and dalangdang brought in by barangay merchants who utilize Cagayan River as a direct means of transportation. Canned fish goods, as Japanese sardines, salmon, and canned oysters, are displacing American canned fish goods in the interior towns.

FISHERIES OF NUEVA VIZCAYA PROVINCE

Nueva Vizcaya Province is an inland province drained by Magat River, a branch of Cagayan River. The towns of Bagabag, Solano, Bayombong, and Santa Fé bordering Magat River have minor fisheries. The gear used for catching fish in Magat River are tabocol, *caput,* hook and line, bobo, asar, and *palingato.* The fishes caught are mullets (lodong, *lapez*) bulanbulan, sisiao, *ayuñgin,* kurilao, gobies, dalag, paltat, and araro. Fishing in these municipalities is free as there are no records of fishery collections.

Pinapagan, a remote town on the eastern side of the province, is located near the headwaters of Cagayan River. The important fisheries of Nueva Vizcaya are located in this place. The lodong is the most important fish caught with tabocol and

tabac. The fisheries of Pinapagan were leased to the highest bidder in 1934 for 29 pesos, in 1935 for 71 pesos, in 1936 for 173 pesos, and in 1937 for 107 pesos.

FISHERIES OF BATANES PROVINCE

The Batanes Islands consist of a chain of islands, mostly high-lying, north of the Babuyan Islands, extending from 20° 17′ to 21° 0.06′ north latitude. The channels among them are thought to be safe and free from danger. The larger islands indicate a volcanic origin. Itbayat, Batan, and Sabtang are particularly mountainous, with valleys and plains sloping to the shore and well-watered small rivers. The smaller islands are generally low and rest on coral foundations.

The inhabitants possess many of the characteristics of the races of Taiwan or Korea, and their peculiar dialect indicates their exclusiveness.

Batan Island is the most important of the group, being second in size. Basco, the capital of Batanes Province, is on the west side of the island at the foot of Mount Irada. The smaller towns of Batan are Mahatao, Ivana, and Uyugan. Itbayat Island, the largest of the group, lies 14 miles north-northwest of Batan. Itbayat Island is a town in itself. It is about 8 miles long and has an area of 28 square miles. Sabtang Island is separated from the southwest end of Batan by a safe channel over 2 miles wide. It also is a town in itself. Other smaller islands of the Batanes Group are Yami, North, Mabudis, Siayan, Ibugos, Dequez, and Balintang Islands. There are about 15,000 inhabitants in the Province. The chief industry is raising cattle, hog, horses, and goats. Fishing is a minor industry, although this region is very rich in aquatic resources.

Table 7 shows the fees collected for fishery privileges of Batanes Province.

TABLE 7.—*Fees collected for fishery privileges in Batanes Province.*

Municipality.	1935	1936	1936
	Pesos.	*Pesos.*	*Pesos.*
Basco	69.00	65.50	60.00
Mahatao	94.50	89.20	93.70
Ivana	71.55	61.20	49.80
Uyugan	75.40	62.00	58.30
Sabtang	54.04	52.28	41.36
Itbayat	2.80	7.90	7.00
Total	367.29	338.08	310.16

The people are satisfied with what they obtain for food, such as coral fishes, game fishes, sea turtles, seaweeds, coconut crabs, octopus and squids, *rarang* trochus shells, and trepang.

The fishery methods are very primitive. Chinchorros or daclis are not used. The most common gear are mamasid, handline fishing, bobo, *manono* (*pana*), a spear gun for coral fishes and octopus; *mamaclid,* a small drag seine about 3 meters long and about 1 meter wide with white squash float and lead sinkers; *toyotoyan,* a small dip net for coral fish; *doddoc,* a dip net used in connection with torch-light fishing for flying fish; and *manoaymasin* or *ivoya sakag* (scissor nets).

Fishing is very limited; only what is needed is gathered. When there is an excess catch it is dried. Preserved fish like bagoong, and canned goods come directly from Manila and Aparri every other three months.

Fishing grounds.—Game fishing for pampanos, talakitok, barracuda, flying fish, and others is carried on around Itbayat, Batan, and Sabtang Islands along the Channel. Coral-fish fishing is localized along the shores of Basco, Mahatao, Ivana, and Uyugan. The gathering of seaweeds, balat trepang, and trochus and rarang shells is done along the coral shores and deeps of these regions. Turtle fishing is centered at Siayan Island.

The Japanese fishing activities in the Batanes Province are of some importance. Japanese fishermen equipped with fast motor boats and troll lines very often visit Itbayat and the Babuyan Islands for game fishes. Others come purposely to gather seaweeds and trochus and rarang shells.

During my trip to Batanes, from June 2 to 6, 1937, the Government Boat Arayat caught a Japanese motor fishing boat at the Babuyan Islands and brought the crew of fishermen to Basco. The Arayat patrolled Itbayat and returned to Basco for the Japanese fishermen and boat and took them to Aparri.

A regular patrol of one of our government boats in the Batanes Province and the Babuyan Islands is recommended to apprehend these illegal fishermen that unlawfully gather our fishery resources.

CONCLUSIONS AND RECOMMENDATIONS

1. Northeastern Luzon and the adjacent group of islands have various fishing resources; namely, the aramang or shrimp fisheries; the lodong or mullet fisheries; the ipon or goby-fry fish-

eries; the sea-catfish or kurilao fisheries; the fresh-water catfish or paltat fisheries; the hairtails or bolungnas fisheries; the croaker or tuel fisheries; the sardine and anchovy fisheries; the siganid-fry (padas) fisheries; the molluskan or cabibi and gacca or bean-clam fisheries; the edible and medicinal seaweeds.

2. Aparri, being a fishing center, is an ideal location for an experimental station similar to that of Catbalogan, Samar, where experiments on the improvement of making bagoong, salting, drying, smoking, and patis making, may be conducted. Research on the life histories of important fishes, crustaceans, and mollusks should be conducted.

3. Careful and sanitary methods of handling fishery products, like making bagoong; drying sardines, anchovies, and aramang must be observed.

4. Better methods of fishing, such as sapiao, and kubkub (purse seines) may be introduced for pelagic fishing in Aparri, Buguey, Ballesteros, Gonzaga, and Claveria.

5. Regular patrol work should be conducted in Batanes and Babuyan Islands to check illegal fishing by foreigners.

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ILLUSTRATIONS

Plate 1

FIG. 1. Chinchorro fishing; type of barangay boat used for chinchorro-net fishing at Aparri, Cagayan Province.
2. Pulling a chinchorro net from the beach.
3. Mending a chinchorro net at Aparri fishing village.
4. A boat (balasiang) for shrimp fishing.

Plate 2

FIG. 1. Operation of balasiang boat and bannuar net at the mouth of Cagayan River.
2. Mending a bannuar net at Aparri.
3. Taco dredge sieve for gathering cabibi (*Corbicula flumminea* Müller) at Catayaoan, Lallo, Cagayan River.

Plate 3

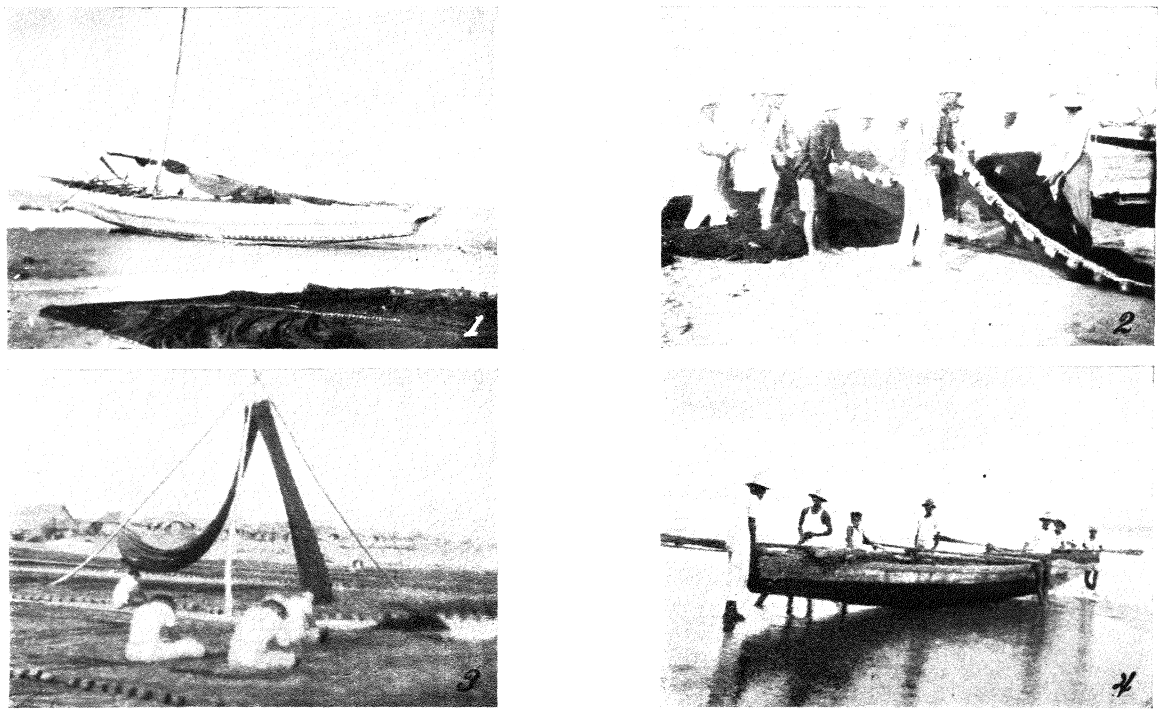
FIG. 1. Pateng bobo for catching lodong, *Mugil seheli* Forskål.
2. Pateng bobo showing circumference.
3. Taco dredge sieve for gathering gacca, *Donax radians* Deshayes.
4. Fishermen showing operation of taco at a flat sandy beach at Aparri.

Plate 4

FIG. 1. Balasiang boat for hand-line bantac fishing.
2. Bantac fisherman and fish dealers.
3. A group of fish merchants.

Plate 5

FIG. 1. Platform showing croakers and sea catfish in the process of sun-drying.
2. Empty earthen jars, tinajas, or burnay, for bagoong containers.
3. Loading a carabao cart with empty burnay from a barangay boat.
4. A cart load of bagoong.



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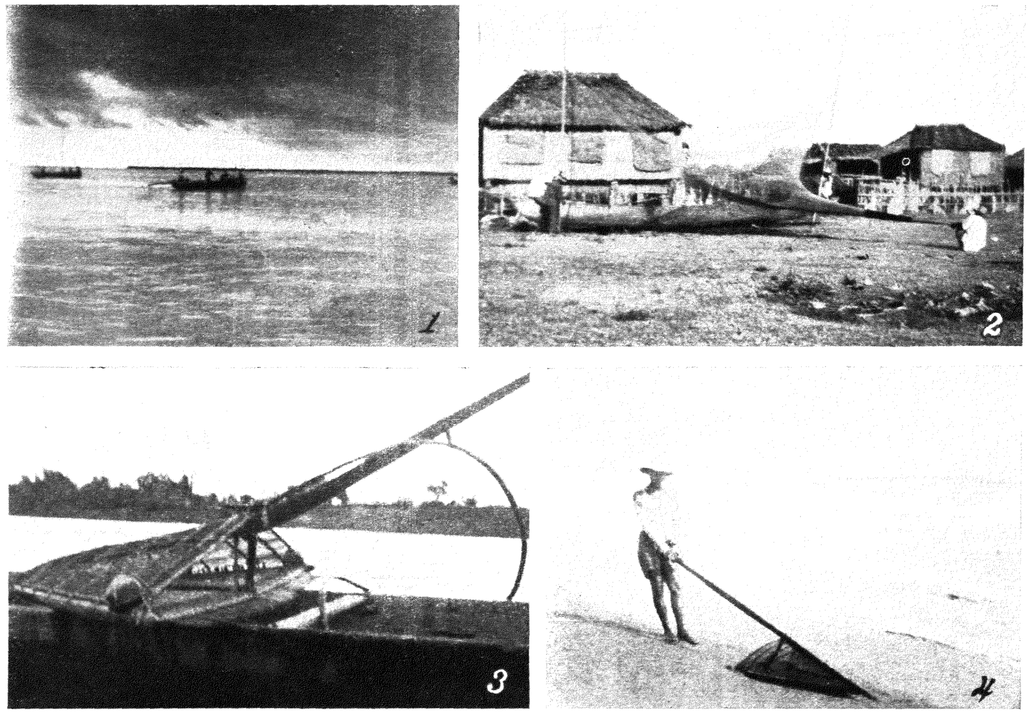

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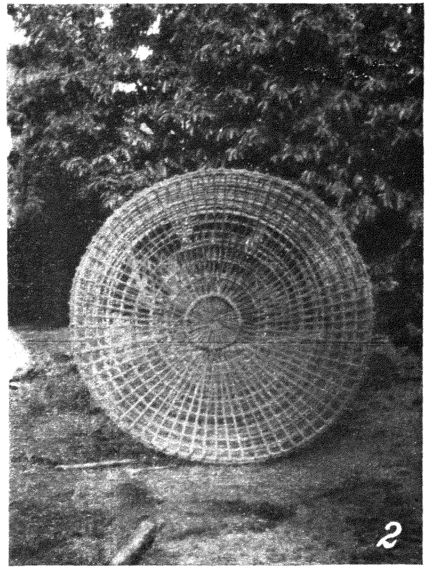

PLATE 3.

PLATE 4.

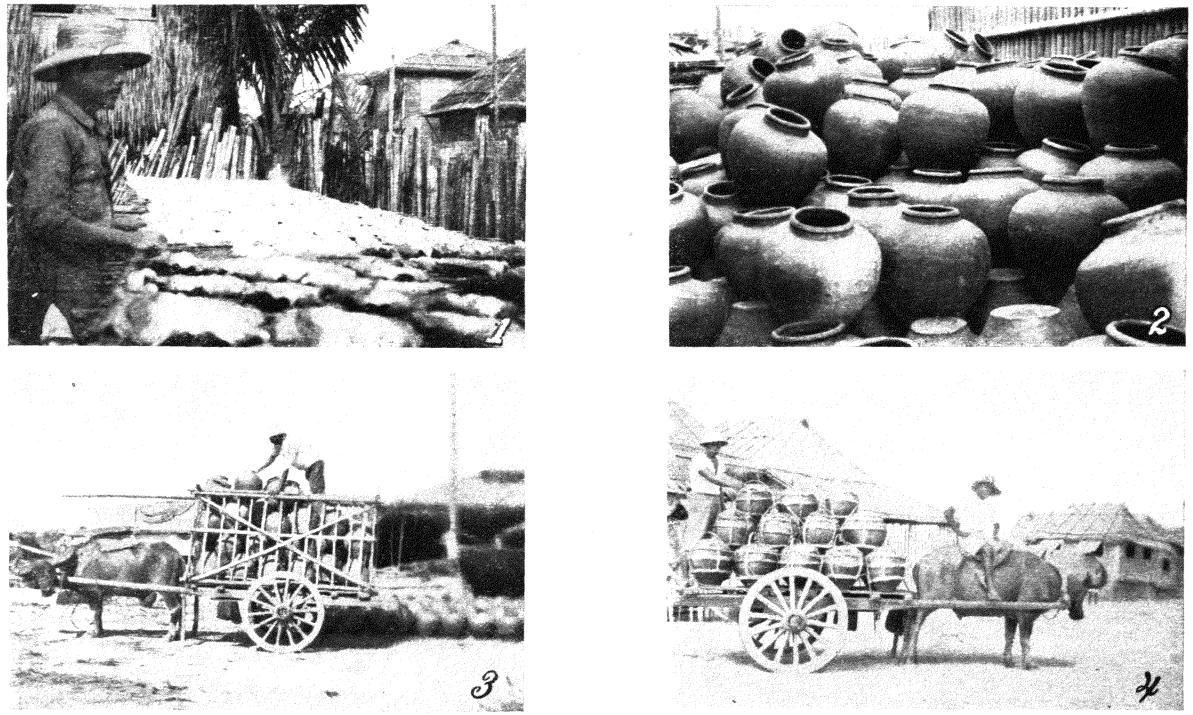

PLATE 5.

BOOKS

Acknowledgment of all books received by the Philippine Journal of Science will be made in this column, from which a selection will be made for review.

REVIEWS

Auto-correctivism; The Psychology of Nervousness. By V. E. Fisher. Caldwell, Idaho, The Caxtan Printers, Ltd., 1937. 337 pp. Price, $3.50.

Students of the psychology of nervousness who had become lost in the conflicting interpretations of neurotic symptoms by such well-known men as Janet, Babinski, Rosanoff, Freud, Adler, Jung, Rivers, Prince, and McDougall, to mention a few, should read this very illuminating book of Doctor Fisher. The theory advanced by him in this book, Auto-Correctivism, is that the neurotic symptom is the friend of the neurotic patient, "that it is a truly purposive arrangement, and that he absolutely needs it at the time."

The individual, says Doctor Fisher, is governed in his goal-seeking activities by two sets of powerful motives—the racial or selfless motives which urge him to utilize his energies for the sake of the race, and the ego or selfish motives which incline him to activities that will give him a sense of individual and personal autonomy.

These two powerful sets of motives naturally are antagonistic to each other, but in every individual "there exists some regulatory principle which operate in such a manner as to thwart the over extension of either set of motives thereby maintaining a quantitative balance between them". This principle Doctor Fisher calls the auto-corrective motive. When one of these sets of motives becomes exaggerated, this auto-corrective motive operates to maintain a balance. The neurotic's symptom then is to be interpreted as his auto-corrective attempt to maintain a mental balance.

The book is replete with illustrative cases drawn from the author's long practice as a psychotherapist. Written for laymen and students of psychology as well as for psychotherapists, the book should also prove helpful to psychiatrists who deal with mental and nervous disorders.—S. G. P.

Pig Breeding and Feeding; The Breeding and Feeding of English Swine in an English Climate for the English Market. By Charles Forman. London, Faber and Faber Ltd. 173 pp. Price, 6s.

This book is written by a practical English hog raiser and consists of thirteen chapters with no pictures. In general it discusses the seven important English breeds of swine: Large White, Large Black, Middle White, Berkshire, Wessex, Essex, and Tamworth. In a very practical way the author discusses the questions of instincts, breeds and breeding, management of the brood stock, diseases, land requirements, labor, water supply, and housing. He discusses also foodstuffs, methods of calculating rations, feeding, capital cost, and marketing.

The reviewer wishes to mention a few of the author's ideas that are not ordinary. He says that he feeds dry meals on the ground inside the folds because no matter where the meal is put it eventually lands on the ground. He says also that ditch water, if not stagnant, or stream water, is much better than water from a hydrant of a water company supply. Lack of sunlight causes anæmia. The author attributes the remarkable quality of English stock to English land and climate and says that the winds and rains remineralize the English soils yearly with 20 to 40 lbs. of iodized salts to the acre. The following quotation from this chapter is full of meaning—"With equitable climate, and water and feed plentiful, it is a veritable stockman's paradise—yet where is the stock?"—C. X. B.

Children Handicapped by Cerebral Palsy; Psychological Factors in Management. By Elizabeth Evans Lord. With a Medical Explanation by Bronson Crothers. New York, The Commonwealth Fund, 1937. 105 pp., illus. Price, $1.25.

This book by Doctor Lord is the result of her years of experience in dealing with children handicapped by cerebral palsy. She presents the results of her work on 300 cases of children suffering from birth injuries, including the psychological problems in muscle training, mental development and testing, and emotional problems. While in the Philippines little work has been done among children so handicapped, this book should be read not only by clinical psychologists, but also and especially by pediatricians.—S. G. P.

The Baby and Growing Child; Feeding and Health Care For Physicians, Mothers, and Nurses. By Louis Fischer. New York and London, Funk & Wagnalls Company, 1936. 260 pp., illus. Price, ₱1.50.

This book is what many housewives need in the home, where many problems and emergencies arise. Many of these are met through misguided and often harmful advice of well-meaning neighbors and friends. In this book, written by a baby specialist, many questions encountered in bringing up a child are answered. The book includes prenatal hygiene, care and feeding of children, and much valuable information on early recognition of serious diseases, on hardening children, and simple first-aid remedies for accidents and diseases when the doctor has not yet arrived. The author should have included a simple guide in selecting a good family physician.—I. F.

Industrial Chemistry; An Elementary Treatise for the Student and General Reader. By Emil Raymond Riegel, with the Support of a Large Number of Collaborators. 3d Edition. New York, Reinhold Publishing Corporation, 1937. 851 pp., illus., tables. Price, $5.75.

This book compresses, in less than 900 pages, the treatment of the most important industries in the United States and in other industrially advanced countries, in a very readable and precise way. The subjects treated in the book are divided into fifty chapters. The chapter headings given in the table of contents speak for themselves.

The author is a professor of industrial chemistry in the University of Buffalo, New York. But aside from his general knowledge as an academic man, he has availed himself liberally of information from research directors, managers, engineers, and chemists, from United States government offices, such as the Bureau of Census, the Bureau of Mines, the Bureau of Foreign and Domestic Commerce, the Bureau of Agricultural Economics, the Bureau of Chemistry and Soils, the Bureau of Plant Investigations, the United States Tariff Commission, the United States Patent Office, and from public institutions of some foreign countries.

His treatment of each of his chapters is very interesting and laudable. He starts with statistics to show trends in production. Then he analyses the broad principles involved and describes different methods and equipment to take care of these principles. In many cases he discusses the sources of raw materials; the uses of, and markets for, the products; efficiency; and cost of production. Add to these his citations of pertinent patents and references, and we have a book valuable not only to

the student but also to the chemist, the chemical engineer, the industrialist, and the general reader. The book has a good index.—V. G. L.

Practical Goat-Keeping. By Mrs. Arthur Abbey. London, Cassell & Company, Ltd., 1935. 114 pp., plates. Price, 1s. 6d.

In this book the author has recorded her experience in raising milch goats, and presented it in a popular style that can easily be understood by the layman. The different phases of the care and management of goats are discussed in fourteen separate chapters on breeds, housing, choosing stock, management, goatlings, breeding, kidding, kid-rearing, disbudding, feeding and foods, the male, shows and showing, ailments, and nursing. The chapter on choosing stock contains all the pointers necessary to a beginner, presented in simple manner. The book also brings information on the most common ailments and their treatment, and emphasizes the fact that veterinary assistance is advisable in most ailments of goats.

This book would be a good reference for farm schools, and should be read not only by animal husbandmen but also by livestock farmers.—M. M.

Strange Birds and Their Stories. By A. Hyatt Verrill. Boston, L. C. Page & Co., 1938. 203 pp., illus. Price, $2.50.

Based largely on keen observation and written in the language of the layman, the author pictures some of the marvels of bird life. This book is easy reading, being devoid of technical terms. It is the type of reading matter needed in a campaign for bird conservation, as it will urge those uninterested in bird life to go to Nature. Moreover, it will stimulate students of birds to further observation.

The peculiarities of birds are presented in twenty chapters, each chapter describing a particular trait, supplemented with examples and illustrations.—C. G. M.

Nursery Education; Theory and Practice. By William E. Blatz and Dorothy Millicamp and Margaret Fletcher. New York, William Morrow and Company, 1935. 365 pp., plate, tables. Price, $3.50.

This book deals with the theory and practice of nursery education as applied by the authors in their St. George's School of Child Study, under the University of Toronto, Canada. The authors, in their preface, write, "the suggestions as to nursery school practices have been found satisfactory by the empirical test of use in the nursery school, in the home, and in the clinic.

Upon this basis they are offered and recommended. The theories that are appended are the products of the authors' imaginations and ingenuity and are offered only for what they are worth."

The authors' theory of education is "to train the growing child for full adult responsibility." Nursery education then, is "not the development of genius, nor the acquisition of specific skills, nor the substitution of institutional or parental care. It is an arrangement whereby the child may begin, at a most appropriate age, the cultivation of a plan of living under auspicious circumstances for cultural, appetitive, emotional, and social fulfillment."

Nursery education is a new thing in the Philippines. Outside of a few kindergarten schools in and around Manila, there is probably no definite program in the Philippines concerning nursery education. We can therefore see the need of a more systematic program of nursery education to supplement the child training in the public schools. In the absence, however, of such a program, it would be well for the more enlightened parents, teachers, and others interested in nursery education to read books dealing with problems such are discussed in the book under review.

In eight chapters the authors discussed the different phases of nursery education; such as routine in a nursery school, work and play habits, social adjustment of the preschool child, emotional adjustment of the preschool child, the nursery school and the parent, the preschool child's diet, and physical health. The reviewer finds that many of the actual procedures suggested in the treatment of nursery routine and work and play habits are inapplicable to Filipino children, as is to be expected, since the book is written for Canadian and American children. However, it would do well for parents and nursery school teachers to adopt as much as possible of the technics suggested by the authors.

On the whole, the book contains delightful and instructive reading for one who is vitally interested in the training of the neglected child—the preschool child.—S. P.

Chemical Analysis of Metals and Alloys. By Edwin Gregory and Walter W. Stevenson. With a Foreword by Thomas Swinden. London and Glasgow, Blackie & Son Ltd., 1937. 375 pp., illus. Price, 15s.

Some training in theoretical chemistry is required to understand properly the first half of this book, which is an excellent

reference book for analytical and routine chemists whose work deals with the metallurgical products—particularly those of iron and steel.

Depending on the subject matter, the book can be logically divided into four parts. The first of these (Chapter I, 66 pages) deals with "fundamental chemical principles." The second (Chapter II, 115 pages), gives a survey of the chemical properties of the elements which are studied in the order of the periodic classification given in Chapter I. The third (Chapter III, 19 pages) describes briefly and clearly those "preliminary operations and considerations," vitally necessary in the making of accurate analyses. The fourth and last part (Chapters IV to VIII, 147 pages) gives methods of analyses for iron and steel, ferro-alloys, ores, and slags, and nonferrous alloys. A very useful appendix is given, including tables of chemical factors, analyses of metallurgical products, and the international atomic weights. Finally the book provides a full and very satisfactory index.

The short but very lucid review of "fundamental chemical principles" includes first a definition and discussion of the periodic classification of the elements by Mendeleef. This is extended and correlated with the modern theory of electrons.

It would seem that some mention should have been made of the "activity coefficient" because of the increased attention this has been receiving from American authors of theoretical chemistry.

Relatively short, considering the large ground covered, but clear and logical, is the second part of the book dealing with the elements and their compounds. These are studied systematically according to the periodic classification. The elements are first considered. The space allotted is in proportion to their usefulness.

In a general way this part of the book can be summarized as an abbreviated, but excellent dovetailing of inorganic with analytical chemistry, including industrial application. This last point adds to the practical interest of the book and is very advantageous.

The third part of the book reviews and describes clearly these preliminary operations that must be mastered before successful chemical analyses can be made. The theory of the chemical balance is clearly given. The best conditions for accurate weighing are then discussed.

A considerable amount of space is devoted to the description of methods of analysis for the determination of gases like oxygen, nitrogen, and the like, in steel. A similar remark applies to the determination of the rarer elements like chromium, molybdenum, tungsten, cobalt, vanadium, titanium, and even columbium, zirconium, and tantalum. These are most excellent features and they greatly improve and make more comprehensive a work of relatively small compass, considering the many subjects treated.

Swinden in the Foreword makes this statement: "And may I direct a word or two to those who only use the results of the metallurgical chemist, asking them to remember all the training, skill, strain and, literally hard labour attached to the work of the so-called routine chemist? He is involved daily in work calling for a very high degree of skill when a single lapse of accuracy may result in untold trouble." It would be well if a number of other men who use the results of the metallurgical and other analytical chemists and profit therefrom would take these words of Swinden deeply to heart.

Finally, "Chemical Analysis of Metals and Alloys" is a most excellent reference book for technical analytical chemists whose work has to do with metallurgical products, and the authors deserve praise for their production.—R. G. M.

Strange Insects And Their Stories. By A. Hyatt Verrill. Boston, L. C. Page & Company, c1937. 205 pp., illus. Price, $2.50.

This book is an interesting popular account of the different phases—the mysterious lives and habits—of insects and their near relatives as observed by the author. The following remark by the author is interesting, "No one knows, no one can say, but the more we study insects, and the more we learn of their strange habits and their stories, the more we are convinced that there must be a Supreme power which regulates the lives of all things and functions on a definite Plan which Nature must inevitably follow."

The author presents in simple language the intelligence of insects, the different activities of the various kinds and species of insects duplicating the art, industry, and other phases of human activities, the curious traits of insects, the insect ways in their struggle for existence, and the menace and benefits they give to mankind. Insects live like human beings. As the author says, "There are insect masons, carpenters, weavers,

divers, aviators and bridge builders. There are insect soldiers and sailors, insect miners and farmers, insect basket makers and engravers, insects who keep cattle, and insects who have slaves. There are lazy insects and industrious insects. Insects with well built fixed homes and insects hoboes. Some insects are quarrelsome, quick-tempered, morose or vicious, while others are easy-going, docile, good natured and give the impression of being always happy." A very interesting chapter is the one on insects that are not insects, because the strangest and most interesting features of the habits and lives of these peculiar insects are vividly presented. A discussion on the insects used as food by man, such as grasshopper, crickets, ants, grubs, termites, and others, is included under one chapter. The last chapter will be of interest to students and beginners interested in collecting and studying insects, as it gives hints on how to find and study them.—S. R. C.

INDEX

[New names and new combinations are printed in **boldface.**]

A

Aber, 506.
ABLAN, GUILLERMO L., The diwal fishery of Occidental Negros, 379; *see also* ROXAS and ABLAN.
ABLAN, GUILLERMO L., and GODOFREDO L. ALCASID, Two species of Pinna apparently new to the Philippines, 497.
Ablennes hians (Cuv. and Val.), 506.
Abunog, 27.
Acanthocephala, 3.
Acanthopora orientalis, 512.
Accipiter trivirgatus trivirgatus (Temm.), 20.
ACEVEDO, RAMON A., and TEODULO TOPACIO, Differentiation of cattle and carabao meat by biochemical methods, I. Differentiation of unrefrigerated and frozen meat, 281.
Achnanthes affinis Grun. var. **bistriata** Skv., 482.
  biasolettiana Kütz., 49.
  fragilis Skv., 161, 166, 343, 346.
  lanceolata Breb., 346.
  lanceolata Breb. var. rostrata Hust., 49.
  linearis W. Sm., 166, 483.
  linearis W. Sm. var. pusilla Grun., 166.
  microcephala Kütz., 482.
  minutissima Kütz., 166, 483.
  peragalli Brun and Herib. var. nipponica Skv., 44, 49.
  pinnata Hust., 479, 482.
  sublinearis Skv., 479, 483.
  sublinearis Skv var. **complexa** Skv., 483.
  sublinearis Skv. var. **elliptica** Skv., 483.
Acrothecium rubiginosum Roldan, 10.
Actinocylus Ehr., 480.
  crassus Van Heurck, 480.
  Ehrenbergii Ralfs var. crassa (W. Sm.) Hust., 479, 480.
  Ehrenbergii Ralfs var. sparsa (Greg.) Hust., 480.
  subcrassus Rattray, 480.
Actitis hypoleucos (Linn.), 20.
Addá, 418, 425.
Adelphomyia Berg., 324.
  helvetica Berg., 324.
Adú, 432.
Æthopyga bella Tweedd., 31.
AFRICA, CANDIDO M., Description of three trematodes of the genus Haplorchis (Heterophyidæ) with notes on two other Philippine members of this genus, 299.
Agad-agad, 32.
Agaricus, 370.
  boltoni Copel., 369, 370.
Agrostophyllum, 150.
Agum-um, 19.
Alagit-it, 271.
Albacore, 507.
ALCASID, GODOFREDO L., *see* ABLAN and ALCASID.
Alcedo atthis bengalensis Gmel., 273.
ALEXANDER, CHARLES P., New or little-known Tipulidæ from eastern Asia (Diptera), XXXVI, 93; XXXVII, 221; XXXVIII, 309; XXXIX, 439.
Alimoking, 506.
Aliso, 506.
Amalopina Brun., 117.
Ambassis spp., 506.
Amia spp., 506.
Amphacanthidæ, 507, 511.
Amphacanthus, 511.
  doliatus C., 511.
  hexagonatus (Blkr.), 511.
  oramin Bl. and Schn., 511.
  sutor Cuv. and Val., 511.
  virgatus (C. and V.), 506, 511.
Amphiphora ornata Bail., 487.
Amphora libyca Ehr., 354.
  mongolica Oestr., 479, 487.
  ovalis Kütz., 61, 487.
  ovalis Kütz. fo. gracilis (Ehr.) Cleve, 61.
  ovalis Kütz. var libyca (Ehr.) Cleve, 61, 354, 487.
  ovalis Kütz. var. pediculus Kütz., 487.
  veneta Kütz., 44, 62.
Ampullaria luzonica Reeve, 510.
Anabas testudineus (Bl.), 506.
Anadontostoma chacunda Buch.-Ham., 506.
Anatina truncata Lam., 510.
Anchovia commersoniana Lacép., 506, 507.
Anchovy, 506.
Anduquil, 510.
Anguilla mauritiana Benn., 506, 507.

Aniculus Alcock, 183, 201.
Dana, 185, 201.
Stebbing, 201.
aniculus Alcock, 201.
aniculus (Herbst), 201.
typicus Ortmann, 201.
Anomoeneis sphaerophora (Kütz.) Pfitz., 43, 44, 52.
Anomura, 183.
Anthreptes malaccensis griseigularis Tweedd., 31.
Anthus rufulus Vieillot, 271, 272.
Antidesma ghaesembilla Gartn., 268.
Antimony, determination of, in high-lead mixtures by a modified permanganate method, 75.
Antipara, 381.
Antocha (Antocha) **emarginata** Alex., **470**, 471.
(Antocha) **flavidibasis** Alex., **318**, 319.
(Antocha) morio, 318.
(Antocha) nebulipennis Alex., 318.
(Antocha) nebulipennis **immaculata** Alex., **319**.
Aplonis panayensis panayensis (Scop.), 271, 272.
Arachnothera flammifera, 15.
philippinensis (Steere), 32.
Aramang, 503.
Ararusip, 512.
Araucoderus Alex., 224.
Arca antiquata Linn., 510.
Arius spp., 506.
Arraro, 506.
Arraro-baybay, 506.
ARRIOLA, FELIX J., *see* VILLALUZ and ARRIOLA.
Arsenic, effect of, on the determination of antimony in high-lead mixtures by a modified permanganate method, 75.
Artamus leucorhynchus leucorhynchus (Linn.), 30, 271.
Asar, 515.
Atherina forskalii Rupp., 507.
Avifauna of the Gigante Islands, 267.
Awa, 506.
Awán, 419, 427.
Ayuñgin, 516.

B

Babayo, 506.
Babayote, 506.
Babuyan Islands, fisheries of, 514.
Badong-badong, 510.
Bagabaga, 506.
Bagoong making, 513.
Baguis, 382.
Bailañgaoan, 506.
Bakaka, 23.
Bakilya, 506.
Balagbagan, 506.
Balaki, 506.
Balalatok, 28.
Balasiang, 503.
Balbaliga, 506.
Balbalulang, 513.
Balete, 17.
Balingasa, 510.
Balla, 506.
Balud, 18.
Banasak, 506.
Banog, 20.
Bannuar, 502.
Bantac, 502.
Bañgos, 398, 506.
Baraniti, 506.
Barañgan, 506.
Baraoñgan, 506.
Barasot, 506.
Barisbaris, 513.
Baronbarong, 510.
Baroto, 381.
Barracuda, 506.
Bassit, 432.
Batanes Province, fisheries of, 517.
Batawayi, 511.
Batobot, 506.
Batok, 28.
Batrachostomus septimus septimus Tweedd., 23.
Begsang, 506.
Belony, 511.
Bercacan, 506.
Bernhardus Dana, 208.
Bibigan, 510.
Bilis, 506.
Bill fish, 507.
Binayoyo, 268.
Birds from Leyte, 15.
Birgus Alcock, 183, 184, 214.
Henderson, 214.
Leach, 209, 214.
Milne-Edw., 214.
laticauda Desmarest, 214.
latro (Herbst), 214.
latro Leach, 214.
Bisocol, 510.
Bitilla, 506.
Black-backed coleto, 272.
BLANCO, GUILLERMO J., Fisheries of northeastern Luzon and the Babuyan and Batanes Islands, 501.
Bobó, 502.
Bodobodo, 512.
Bolbopsittacus intermedius Salv., 22.
Bolungnas, 503.
Bombra, 506.
Books, 135, 275, 391, 523.
Borador, 506.
Bucayo, 406.
Bugui, 506.
Bukto, 506.
Bulanbulan, 506.
Bunaka pingius Herre, 506.
Bunog, 506.

Buro-buro, 17.
Butorides striatus javanicus (Horsf.), 269.

C

Cabibi, 502.
Cacomantis merulinus merulinus (Scop.), 269, 272.
Cadis, 506.
Cæsio, 506.
 cærulaureus (Lacép.), 506.
 cuning Bl., 398.
 spp., 506.
Calcinus Alcock, 183, 185, 204.
 Dana, 185, 204, 205.
 Henderson, 204.
 elegans Dana, 206.
 elegans (Milne-Edw.), 205, 206.
 herbstii de Man, 205.
 intermedius de Man, 207.
 latens Alcock, 207.
 latens (Randall)), 205, 207.
 terræ-reginæ Haswell, 205–207.
Callisia Veitchiana O. K., 144.
Callisitta frontalis lilacea (Whitehead), 30.
Caloneis bacillum (Brun) Meresch., 50.
 bacillum (Greg.) Meresch., 347.
 bacillum (Grun.) Meresch., 484.
 patagonica Cleve var. sinica Skv., 484.
 schroederi Hust., 44, 50.
 silicula (Ehr.) Cleve, 43, 50, 347.
 silicula (Ehr.) Cleve var. alpina Cleve, 167.
 silicula (Ehr.) Cleve var. truncatula Grun., 484.
 sphagnicola Skv., 161, 167, 343, 347.
Caloptera nepalensis Westw., 247.
Campa, 506.
Canauihan, 22.
Cancellus, 185.
Cancer aniculus Herbst, 201.
 clibanarius Herbst, 190.
 clypeata Herbst, 213.
 crumenatus Rumph, 214.
 crumenatus orientalis Seba, 214.
 latro Herbst, 214.
 megistos Herbst, 197.
 sclopterarius Herbst, 192, 193.
Canna indica Linn., 11.
Canotcanot, 513.
Cao, 24.
Cappo, 516.
Caprimulgus, 25.
 macrurus manillensis Walden, 25, 33.
 sp., 273.
Caput, 516.
Carabao meat, differentiation of, by biochemical methods, 281.
Caraboyo, 516.
Caranx auriga Seale, 507.
 spp., 507.
Cardinal fish, 506.
Carpophaga aenea, 18.
Carex, 161.
Catfish, 507; sea, 506.
Cattle meat, differentiation of, by biochemical methods, 281.
Caulerpa freycinetti, 512.
 racemosa var. uvifera, 512.
 sertularioides, 512.
Cavalla, 507.
Cawatcawat, 512.
Centaurea sp., 9.
Centropus bengalensis javanensis (Dumont), 270, 272.
 melanops Lesson, 27.
 viridis (Scop.), 27.
Cephalopoda, 510.
Ceratoneis arcus Kütz., 47, 479, 481.
Cercospora cruenta Sacc., 8.
 fuligena Roldan, 8.
 vaginae Krüger, 7.
Ceyx flumenicola Steere, 23.
 samarensis Steere, 23, 24.
Chaetomorpha crassa Kütz., 512.
 sp., 512.
Chætura picina, 26.
Chalcophaps indica indica Linn., 33, 268.
Chanos chanos Forsk., 398, 506.
Charadrius dubius dubius Scop., 19.
Chemical fractionation of leprotic nodules, I. Isolation of the lipid fractions, 155.
Chinchorro, 502.
Chirocentrus dorab (Forsk.), 506.
Chonophorus melanocephalus (Blkr.), 506, 509.
 ocelaries (Brouss.), 506, 509.
Chrysocolaptes lucidus rufopunctatus Hargitt, 27.
Chub mackerel, 506.
Cicinnobolus, 12.
 cesatii de Bary, 12.
 sigacollis Roldan, 12.
Circe gibba Lam., 510.
 pectinada Linn., 510.
Clarias batrachus Linn., 507.
Clibanarius Alcock, 183, 185.
 Dana, 185.
 Henderson, 185.
 Milne-Edw., 185.
 Stebbing, 185, 186.
 antillensis Stimpson, 186, 188.
 clibanarius (Herbst), 186, 190.
 clibanarius Hilgendorf, 191.
 corallinus Alcock, 187.
 corallinus de Man, 187.
 corallinus Milne-Edw., 186, 187.
 corallinus var. spinatus Yap-Chiongco, 186, 187.
 cruentatus de Man, 189.
 cruentatus Milne-Edw., 186, 189.
 eurysternus de Man, 189.
 eurysternus Hilgendorf, 186, 189.
 infraspinatus Hilgendorf, 186, 191.
 obesomanus Dana, 187.

Clibanarius—Continued.
padavensis de **Man**, 186, 192, 193.
sclopetarius Benedict, 192.
sclopetarius (Herbst), 186, 192, 193.
striolatus Dana, 186, 192.
vulgaris Dana, 190.
vulgaris de Man, 191.
Climbing perch, 506.
Clupeidæ, 506.
Clydonodozus, 250.
curvinervis Edw., 250.
griseiceps de Meij., 250.
multistriatus End., 250.
punctulatus Edw., 250.
xanthoptera Alex., **249**.
Clytocosmus Skuse, 93, 441.
Cocconeis placentula, 479.
placentula (Ehr.) var. euglypta (Ehr.) Cleve, 48, 482.
placentula (Ehr.) var. lineata (Ehr.) Cleve, 48, 482.
Codium tenue Kütz., 512.
Cœnobita Latr., 183, 209, 210.
cavipes Stimpson, 210, 212.
clypeata (Herbst), 210, 213.
clypeata Latr., 213.
clypeata Owen, 210.
clypeata var. puerto-galeræ Yap-Chiongco, 210, 213, 214.
compressus de Man, 210.
compressus Miers, 212.
compressus Nobili, 212.
compressus var. rugosa Bouvier, 210.
perlata Milne-Edw., 210, 211.
perlatus Ortmann, 211.
purpurea Stimpson, 211.
rugosa Milne-Edw., 210.
violascens Hllr., 212.
Cœnobitidæ Alcock, 209.
Dana, 184, 209.
Stebbing, 209.
Collocalia francica germani Oust., 169, 272.
troglodytes Gray, 269, 272.
sp., 33.
Conger eel, 507.
Consumption, food, of one hundred four families in Paco District, Manila, 397.
Copsychus saularis mindanensis (Bodd.), 270.
Coracina striata kochi (Kutter), 29.
Coral fish, 506.
Corbicula fluminea Müll., 509, 510.
Corvus coronoides philippinus Bp., 271.
Crabs, hermit, 183.
Crane flies, 93.
Croaker, 507.
Crustacean fisheries, 505.
Crypteria claripennis (Brun.), 328.
limnophiloides Berg., 328.
luteipennis Alex., **327**, 328.
Cryptolabis (Bæoura) dicladura Alex., 335.
(Bæoura) **perductilis** Alex., **334**, 335.
Crysomonades, 343.
Ctenophora ardens Wied., 224.
Ctenophoraria, 313.
Cuculus canorus, 33.
canorus telephonis Cabanis and Heine, 27.
Cucurbita maxima Duch., 12.
Cucurbitaceæ, 12.
Culot, 513.
Cuncuma leucogaster (Gmel.), 273, 274.
Cutlass fish, 506.
Cybium commersoni Lacép., 507.
Cyclotella glomerata Bachm., 46.
meneghiniana Kütz. fo. plana Fricke, 43, 45.
meneghiniana Kütz. var. laevissima (van Goor) Hust., 480.
meneghiniana Kütz. var. tenera Kolbe, 480.
operculata (Ag.) Kütz., 45.
Cylindrosporium insularum Roldan, 8.
Cylindrotoma, 464.
hypopygialis Alex., **464**.
megacera Alex., **463**.
nigripes Alex., 466.
taiwania (Alex.), 464.
Cylindrotominæ, 442, 463.
Cymatopleura elliptica (Breb.) W. Sm., 44, 493.
elliptica (Breb.) W. Sm. var. nobilis (Hantz.) Hust., 44, 70.
solea (Breb.) W. Sm., 69, 492.
solea (Breb.) W. Sm. var. apiculata (W. Sm.) Grun., 69.
solea (Breb.) W. Sm. var. regula (Ehr.) Grun., 70, 493.
Cymbella aequalis W. Sm., 64.
affinis Kütz., 487.
affinis Kütz. var. excisa (Kütz.) Grun., 488.
affinis Kütz. var. semicircularis Lagerst., 488.
amphycephala Naeg., 355.
amphioxys (Kütz.) Grun. var **asiatica** Skv., 162, **176**.
anglica Lagerst., 62.
aspera (Ehr.) Cleve, 63.
cesati (Rahb.) Grun. var. **asiatica** Skv., 343, **355**.
cistula (Hemp.) Grun., 63, 177, 488.
cistula var. eucistula Mayer fo. typica Meister, 488.
cuspidata Kütz., 43, 64, 488.
cymbiformis (Agardh? Kütz.) Van Heurck, 64.
ehrenbergii Kütz., 63.
gracilis (Rabh.) Cleve, 177, 355.
gracilis (Rabh.) Cleve fo. **sphagnicola** Skv., 162, **177**.
heteropleura Ehr. var. minor Cleve, 64, 177.

Cymbella—Continued.
hybrida Grun., 56, 487.
moelleriana Grun., 44, 63.
moellariana var. nipponica Skv., 63.
naviculiformis Auerswald, 62, 355, 489.
naviculiformis Auerswald fo. **constricta** Skv., 44, **62.**
obtusa Greg., 64.
Pavlovi Skv., 343, **355.**
perpusilla A. Cleve, 176.
perpusilla A. Cleve fo. **elongata Skv.,** 162, **177.**
prostrata (Berk.) Cleve, 44, 63.
rupicola Grun., 487.
semicircularis Lagerst., 488.
similis Kraske, 355.
sinica Skv., 489.
stuxbergii Cleve var. intermedia Wisl., 488.
stuxbergii Cleve var. **tumida** Skv., 479, **488.**
tumida (Breb.) Van Heurck, 64, 177, 489.
tumida (Breb.) Van Heurck var. borealis Grun., 489.
tumidula Grun. fo **recta** Skv., **488.**
turgida (Greg.) Cleve, 63, 176, 354.
turgida (Greg.) Cleve var. minor Skv., 355.
turgida (Greg.) Cleve var. muscosa Skv., 161, 176, 343, 355.
turgidula Grun., 62.
ventricosa Kütz., 62, 354, 488.
Cypselurus oligolepis Blkr., 506.
Cyrena ventricosa Deshayes, 510.
Cyttaromyia Scudder, 464.

D

Daclisan, 513.
Dadali, 506.
Dalag, 506.
Dalagang bukid, 398, 515.
Dalangdang, 504.
Daldalag taaw, 506.
Danguit, 511.
Dardanus Paulson, 194.
haani Rathbun, 197.
Deep-bodied herring, 507.
Dendrobium Sw., 143.
chaemeleon Ames, 143.
ferox Hassk., 144.
macrophyllum A. Rich., 141, 144, 145, 147, 148.
macrophyllum A. Rich. var. veitchianum Hk., 144.
polysema Schlter., 144.
quadrisulcatum J. J. S., 141, 145.
sarcostoma Teijsm. and Binn., 144.
ternatense J. J. Sm., 141, 145, 147.
uniflorum Griff., 146.
veitchianum Lindl., 144.
victoriae-reginae Loher, 143, 144.
(Pedolinum) **gonzalesii Quis., 143.**
Dendrochilum Blm., 141.
Clemensiae Ames, 141, 142.
edanoi Quis., **141.,** 142.
papillosum J. J. Sm., 142.
tardum J. J. Sm., 142.
Demigretta sacra sacra (Gmel.), 269.
Diatoma anceps (Ehr.) Grun., 46, 479, 481.
vulgare Bory, 479, 480.
Diatoms from Argun River, Hsing-An-Pei Province, Manchoukuo, 43.
from a peaty bog in Lianchiho River valley, eastern Siberia, 161.
from a mountain bog, Kaolingtze, Pin-Chiang-Sheng Province, Manchoukuo, 343.
from Chengtu, Szechwan, Western China, 479.
Dicæum cinereigulare Tweedd., 30.
everetti Tweedd., 30.
pygmæum (Kittlitz), 271, 274.
Dicranomyia, 318.
mesosternata Alex., 230.
Dicranoptycha **stygipes** Alex., **113.**
yamata Alex., 113.
Dicranota (Amalopina) dicranotoides (Alex.), 321.
(Amalopina) elegantula (Brun.), **321,** 322.
(Amalopina) flaveola, 320.
(Amalopina) fumicosta Alex., 321.
(Amalopina) gibbera gibbera (Alex.), 322.
(Amalopina) gibbera karafutonis (Alex.), **322.**
(Amalopina) **hyalipennis** Alex., **321,** 322.
(Amalopina) megaplagiata Alex., 322.
(Amalopina) **simplex** Alex., **320.**
(Rhaphidolabis) biloba Alex., 320.
(Rhaphidolabis) **clausa** Alex., **115,** 116.
(Rhaphidolabis) flavibasis (Alex.), 116.
(Rhaphidolabis) polymera Alex., 116.
(Rhaphidolabis) **præcisa** Alex., **319.**
Dicrurus, 29.
hottentottus striatus Tweedd., 32.
Dictenidia, 313.
bimaculata (Linn.), 313.
formosana, 312.
glabrata Alex., **312,** 313.
inæquipectinata Alex., 313.
luteicostalis, 312.
pictipennis, 312.
Didymosphenia geminata (Lyngb.) M. Schmidt, 479, 489.
Digenea simplex (Wulf) C. Ag., 504, 512, 515.
Diogenes Alcock, 183, 202.
Dana, 185, 202.
Henderson, 202.
Stebbing, 202.
avarus Hllr., 202, 203.
brevirostris Stimpson, 202, **203.**

Diploneis bombus Ehr. var. egena A. S., 479, 484.
ovalis (Hilse) Cleve, 50, 167.
ovalis (Hilse) Cleve var. oblongella (Naeg.) Cleve, 50, 484.
puella (Schum.) Cleve, 167.
Diptera, 93, 221, 309, 439.
Distichophyllum, 145, 146.
kenepaiense J. J. S., 146.
xanthophaeum Schltr., 146.
Diwal, 380.
fishery of Occidental Negros, 379.
Doddoc, 518.
Dolichopeza (Dolichopeza) **honshiuensis** Alex., **462.**
(Dolichopeza) issikiella Alex., 110.
(Dolichopeza) **katoi** Alex., **109,** 463.
(Nesopeza) **Thisbe** Alex., **111.**
(Nesopeza) titania (Alex.), 111, 112.
(Oropeza) **fokiensis** Alex., **224.**
(Oropeza) shirakiella (Alex.), 225, 226.
Donax radians Deshayes, 509.
radians Lam., 510.
Ducula ænea chalybura (Bp.), 272.
ænea glaucocauda Manuel, 18.
Duculinæ, 18.
Duko, 269.
Dulong, 509.
Dussumieria spp., 507.

E

Echeneis albescens Temm. and Schl., 387.
Eel, 506; conger, 507; silver piko, 507.
Egretta garzetta nigripes (Temm.), 20, 273.
Electrolabis Alex., 115.
Eleotrid, 507.
Eleotridæ, 508.
Eleotris melanosoma Blkr., 507, 509.
Elephantomyia, 248.
egregia de Meijere, 126.
inulta Alex., 247.
(Elephantomyia) **carbo** Alex., 315, **326,** 327.
(Elephantomyia) pendleburyi Edw., 248.
(Elephantomyodes) egregia de Meijere. 126.
(Elephantomyodes) mackerrasi Alex.. 126.
Elephantomyodes, 248.
Ellipterodes Becker, 127.
Enteromorpha intestinalis (Linn.), 512.
Epinephelus megachir Rich., 506.
Epiphragma (Epiphragma) **sultana** Alex., **324,** 325.
Epithemia sorex Kütz., 44, 66.
turgida (Ehr.) Kütz., 44, 66.
zebra (Ehr.) Kütz., 66.
zebra (Ehr.) Kütz. var. porcellus (Kütz.) Grun., 66.
zebra (Ehr.) Kütz. var. saxonica (Kütz.) Grun., 66.
spp., 44.
Eria Lindl., 149.
aliciae Quis., **149,** 150.
longissima Ames and Quis., 149, 150.
Eriocera, 123, 124, 246.
hilpa (Walk.), 123.
ruficauda Edw., 242.
Erioptera (Erioptera) juvenilis Alex., 337.
(Ilisia) **dichroa** Alex., 337, 338.
(Ilisia) postrema Alex., 338.
Eriopterini, 126, 249, 327, 473.
Erysiphaceæ, 12.
Eucheuma spinosum (Linn.), 512.
Eudrepanis pulcherrima (Sharpe), 31.
Eugynamys scolapacea mindanensis (Linn.), 269.
Eunotia, 343.
alpina (Naeg.) Hust., 165, 345.
arcus Ehr., 163.
arcus Ehr. var. bidens Grun., 163.
asiatica Skv., 161, **164.**
asiatica var. **interrupta** Skv., 161, **165.**
bigibba Kütz. var. pumila Grun., 163.
elegans Oestr., 165.
gracilis (Ehr.) Rabh., 165.
kocheliensis O. Müll., 164.
lunaris (Ehr.) Grun., 48, 165.
lunaris (Ehr.) Grun. var. capitata Grun., 345.
lunaris (Ehr.) Grun. var. subarcuata (Naeg.) Grun., 345.
major var. asiatica Skv., 345.
monodon Ehr. var. asiatica Skv., 343, 345.
monodon Ehr. var. koreana Skv., 165, 166.
monodon Ehr. var. koreana Skv. fo. **bidens** Skv., 161, **165.**
monodon var. koreana fo. undulata, 343, 344.
monodon Ehr. var. major (W. Sm.) Hust., 48.
papilio Ehr., 162.
parallela Ehr. fo. **asiatica** Skv., 343, **346.**
pectinalis (Kütz.) Rabh., 164.
pectinalis (Kütz.) Rabh. var. minor (Kütz.) Rabh. fo. impressa (Ehr.), 164.
pectinalis (Kütz.) Rabh. var. undulata (Ralfs) Rabh., 48, 345.
praerupta Ehr., 162.
praerupta Ehr. fo. curta Grun., 162.
praerupta Ehr. var. bidens Grun., 162, 345.
praerupta Ehr. var. inflata Grun., 48, 163.
praerupta Ehr. var. inflata Grun. fo. curta Grun., 163.
praerupta Ehr. var. laticeps Grun., 163.
tenella (Grun.) Hust., 163.
tridentula Ehr. var. perminuta Grun., 164, 346.
veneris (Kütz.) O. Müll., 164, 346.
Eupagurinæ Ortmann, 185.

Eupagurus Alcock, 183, 208.
Brandt, 208.
Ortmann, 208.
janitor Alcock, 208.
setifer Haswell, 200.
Euptilostena Alex., 127.
Eurycles amboinensis (Linn.) Lindl., 10.
Eurystomus orientalis orientalis (Linn.), 23, 269.
Eutanyderus Alex., 223, 224.
oreonympha Alex., **221**, 223.
wilsoni Alex., 223.
Excalfactoria chinensis lineata (Scop.), 273.

F

Ficus sp., 17.
Fish, bill, 507; cardinal, 506; coral, 506; cutlass, 506; drying, 514; flying, 506; goat, 506; lizard, 506; parrot, 507; rudder, 506; silver-bar, 506; spotted guitar, 506.
preservation, methods of, 513.
Fisheries of Babuyan Islands, 514.
of Batanes Province, 517.
of Isabela Province, 515.
of northeastern Luzon and the Babuyan and Batanes Islands, 501.
of Nueva Vizcaya Province, 516.
Fishes, jelly, 382; Philippine, 387; rare Philippine, 387.
Flounder, 506.
Flying fish, 506.
Food consumption of one hundred four families in Paco District, Manila, 397.
Fragilaria intermedia Grun., 47.
Fruit pigeon, yellow-breasted, 18.
Frustulia rhomboides (Ehr.) de Toni, 166.
rhomboides Ehr., var. lineolata Ehr., 166.
rhomboides (Ehr.) de Toni var. saxonica (Rabh.) de Toni, 166.
vulgaris Thw., 483.
vulgaris Thw. var. asiatica Skv., 44, 49.
Fucus gulaman, 512.
Fungi, Philippine lower, 7.

G

Gacca, 502.
Galeidæ, 506.
Galgalacgac, 512.
Gallicolumba criniger (Jacquinot and Pucheran), 19.
Gallinula chloropus luzonoi Lletget, 19.
Gallus gallus gallus (Linn.), 16.
Gamet, 513.
Ganotganot, 513.
Garfish, 506.
Gargararao, 513.
Garitan, 506.
Gizzard shad, 506.
Glass perch, 506.
Glossogobius celebius (Cuv. and Val.), **509**.
giurus Buch.-Ham., 506, 509.
Gnathandon speciosus (Forsk.), 506.
Goat fish, 506.
Gobiidæ, 506, 508.
Gobioides Lacép., 261.
Goby, 506.
mud skipper, 506.
Gomphonema acuminatum Ehr. var. brebissonii (Kütz.) Cleve, 65.
acuminatum Ehr. var. coronata (Ehr.) W. Sm., 343, 356, 489.
acuminatum Ehr. var. turris (Ehr.) Cleve, 356.
angustatum (Kütz.) Rabh., 356.
angustatum (Kütz.) Rabh. var. producta Grun., 65.
angustatum (Kütz.) Rabh. var. sacrophagus (Greg.) Grun., 356.
angustatum (Kütz.) Rabh. var. undulata Grun., 357.
augur Ehr. var. gautieri Van Heurck, 65.
constrictum Ehr., 65.
constrictum Ehr. var. capitata (Ehr.) Cleve, 65.
gracile Ehr., 489.
heideni Hust. var. **sinica** Skv., **490**.
intricatum Kütz., 490.
intricatum Kütz. var. pumila Grun., 357.
kaznakowi Meresch., 479, 491.
kaznakowi Meresch. var. **distincta** Skv., **491**.
lanceolatum Ehr., 490.
lanceolatum Ehr. fo., 65.
longiceps var. montana (Schum.), 178.
longiceps Ehr. var. montana (Schum.) Cleve fo. minuta Skv., 162, 178.
longiceps Ehr. var. subclavata Grun., 490.
olivaceum (Lyngb.) Kütz., 490.
parvulum (Kütz.) Grun., 356, 489.
parvulum (Kütz.) Grun. var. exilissima Grun., 356, 490.
parvulum (Kütz.) Grun. var. subelliptica Cleve, 65.
tergestinum (Grun.) Fricke, 490.
tropicale Brun, 479, 491.
Gonomyia Meig., 126, 127.
alboannulata, 129.
incompleta, 128, 129.
(Euptilostena) jucunda Loew, 127.
(Euptilostena) reticulata Alex., 126.
(Euptilostena) **supernumeraria** Alex., **127**, 128.
(Gonomyia) **principalis** Alex., 330, 331.
(Idiocera) **insidiosa** Alex., **331**, 332.
(Idiocera) **octavia** Alex., **333**.
(Idiocera) punctipennis Edw., 128.
(Idiocera) reticulata Alex., 332.
(Idiocera) shantungensis Alex., 334.
(Lipophleps) acuspinosa Alex., 130.
(Lipophleps) **biaculeata** Alex., **128**, 129.
(Lipophleps) bimucronata Alex., 129.

Gonomyia—Continued.
(Lipophleps) flavocostalis Alex., 330.
(Lipophleps) **horrifica** Alex., **129.**
(Lipophleps) luteimarginata Alex., 330.
(Lipophleps) nubeculosa, 252, 253.
(Lipophleps) pallidisignata Alex., 253.
(Lipophleps) **parvispinosa** Alex., **329.**
(Lipophleps) **phoracantha** Alex., **252.**
Gracilaria eucheumoides Harv., 513.
confervoides (Linn.), 512.
crassa Harv., 513.
lichenoides (Linn.), 513.
Gray snapper, 506.
Grouper, 506.
Grunt, 506.
Guantes, 381.
Guinamos, 511.
Guitar fish, spotted, 506.
Gulaman, 512.
Gumabek, 506.
Guraman, 512.
GUTIERREZ M., and F. O. SANTOS, The food consumption of one hundred four families in Paco District, Manila, 397.
Gymnothorax pictus (Ahl.), 506.
Gynoplistia (Gynoplistia) **albizonata** Alex., **236.**
(Gynoplistia) insolita Walk., 237.
Gyrosigma acuminatum (Kütz.) Rabh., 49, 483.
attenuatum (Kütz.) Rabh. var. asiatica Skv., 44, 49, 483.
scalproides (Rabh.) Cleve, 483.

H

Hagum-hum, 19.
Halfbeak, 506.
Haliastur indus intermedius Gurney, 20, 273.
Halymenia formosa Harv., 513.
Hammerhead shark, 506.
Hantzschia amphioxys (Ehr.) Grun., 67, 491.
amphioxys (Ehr.) Grun. fo. capitata O. Müll., 67, 357.
amphioxys (Ehr.) Grun. var. gracilis Hust., 357.
amphioxys (Ehr.) Grun. var. intermedia Grun., 67, 178.
amphioxys var. mayor, 67.
amphioxys (Kütz.) Grun. var. rupestris Grun., 357.
amphioxys (Ehr.) Grun. var. xerophila Grun., 67.
Haplorchis, 299, 302.
calderoni (Africa and Garcia), 299, 301, 303, 304.
pumilio (Looss), 304, 305.
sisoni Africa, **302,** 304.
taichui (Nishigori), 299, 304, 305.
vanissima Africa, 301, 302
yokogawai (Katsuta), 299, 304, 305.
Hardtail, 506.
Harpactes ardens (Temm.), 26.
Hawk, Asiatic cuckoo, 27; Philippine owl, 21.
Heliaria, 115.
Helius (Helius) **ctenonycha** Alex., **233.**
(Helius) fumicosta Edw., 235.
(Helius) **nigricapella** Alex., **235,** 236.
(Helius) nigriceps Edw., 235, 236.
(Helius) **pavoninus** Alex., **232,** 233.
Helminthosporium hispaniolæ Cif., 9.
Hemiprocne comata comata, 26.
comata major (Hartert), 25, 26.
comata nakamurai, 26.
Hermit crabs, 183.
Herring, 506; deep-bodied, 507; round-bodied, 507.
Heterophyidæ, 299.
Heteroscelus brevipes (Vieillot), 268.
Hevea brasiliensis (HBK) Muell.-Arg., 12.
Hexatoma dichroa, 120, 121.
nepalensis, 122, 123.
verticalis, 119.
(Eriocera) **ambrosia** Alex., **123.**
(Eriocera) **azurea** Alex., **243.**
(Eriocera) **cantonensis** Alex., 124.
(Eriocera) **celestia** Alex., **122,** 123, 124.
(Eriocera) chalybeicincta (Alex.), 243.
(Eriocera) **disjuncta** Alex., **245,** 246, 247.
(Eriocera) **enavata** Alex., **241.**
(Eriocera) ferruginosa (van der Wulp), 122.
(Eriocera) glabrivittata Alex., 244, 245.
(Eriocera) hilpa (Walk.), 124.
(Eriocera) **insidiosa** Alex., 119.
(Eriocera) **juxta** Alex., **246,** 247.
(Eriocera) leucotela (Walk.), 246.
(Eriocera) lunata (Westw.) 237–239.
(Eriocera) mesophyrrha (Weid.), 121.
(Eriocera) **miranda** Alex., **120,** 121.
(Eriocera) morula (Alex.), 125.
(Eriocera) nepalensis (Westw.), 247.
(Eriocera) nigrina (Riedel), 120.
(Eriocera) **nimbipennis** Alex., **240.**
(Eriocera) **nimbipennis stygipes** Alex., **241.**
(Eriocera) nipponensis (Alex.), 120.
(Eriocera) ornata (End.), 238, 239.
(Eriocera) **perlunata** Alex., 239.
(Eriocera) **perornata** Alex., **237,** 239, 240.
(Eriocera) pusilla Alex., 242.
(Eriocera) ruficauda (Edw.), 242.
(Eriocera) selene (O. S.), 244.
(Eriocera) verticalis (Wied.), 120, 240, 241.
(Eriocera) **viridivittata** Alex., **244.**
Hexatomini, 117, 236, 322, 472.
Hierococcyx sparverioides (Vigors), 27, 33.
Hipon suahe, 35.
Hippocampus, 254.

Hirundo daurica striolata Temm. and Schlegel, 270.
tahitica abbotti Oberholser, 270.
Hito, 514.
Holopagurus, 185.
Horse, sea, 254.
Hydroclathrus cancellatus, 513.
Hydrocorax semigaleatus (Tweedd.), 24.
Hyloterpe apoensis Mns., 30.
Hypnea sp., 513.
Hypothymis azurea azurea (Bodd.), 28.

I

Idiocera Dale, 126, 127.
Igat, 506.
Ilec, 506.
Iling, 33.
Immaradu, 506.
Indogan, 511.
Iole everetti (Tweedd.), 29.
philippensis guimaresensis Steere, 270.
Ipon, 506.
fisheries, 508.
Irene ellæ Steere, 29.
Iron, effect of, on the determination of antimony in high-lead mixtures by a modified permanganate method, 75.
Isabela Province, fisheries of, 515.
Isariopsis clavispora (B. and C.) Sacc., 10.
Isocheles, 185.
It-it, 30.
Itumon, 91.
Ivoya sakag, 518.
Ixobrychus cinnamomeus (Gmel.), 20.
Iyo, 506.

J

Jelly fishes, 332.

K

Kabasi, 506.
Kaggo, 510.
Kammag, 511.
Kaó-kaó, 25.
Kilawen, 509.
Kioó, 269.
Kirkiraud, 510.
Kitang, 506.
Ko-kok, 27.
Kolansi, 22.
Koligot, 22.
Kolilising, 22.
Korita, 510.
Kugao, 506.
Kuhao, 269.
Kuileb, 515.
Kuing, 511.
Kulañgit, 506.
Kurapu, 506.
Kurilao, 506.
Kuyug, 511.
Kyphosus cinerascens Forsk., 506.

L

Labahitas, 516.
Labridæ, 507.
Laki, 511.
Lalage nigra chilensis (Meyen), 270.
Lansium domesticum Correa, 8, 9.
Lapes, 506.
Lapolapo, 506.
Layalay, 506.
Layap, 511.
Leatherjacket, yellow, 506.
Lectandra parviflora J. J. Sm., 150.
Leddeg, 510.
Leiognathidæ, 506, 507.
Leiognathus caballus (Cuv. and Val.), 507.
Leme, 261.
mordax de Vis, 261.
purpurascens de Vis, 261.
Lepiota Fr., 363, 364, 375.
americana Peck., 363, 364, 369, 370.
candida Copel., 363, 364, 371, 372.
candida Morg., 371.
cepæstipes Fr., 364, 365, 367.
chlorospora Copel., 363, 367, 368.
cristata Fr., 364, 370, 371.
denundata Rabenhorst, 364, 372, 373.
elata Copel., 375.
fusco-squamea Peck, 370, 371.
gracilenta Krombholtz, 364, 375.
hispida Lasch, 364, 374.
lilacea Bresadola, 364, 371.
manilensis Copel., 365, 366.
meleagris Sowerby, 364, 374.
metulispora Berk., 364, 373.
morgani Peck, 363, 364, 367–369.
philippinensis Mendoza and Leus-Palo, 364.
procera, 365.
pulcherrima (Morg.), 363, 371, 372.
sulphopenita Graff, 372, 373.
Philippine, 373.
Leprotic nodules, chemical fractionation of, 155.
Leptocephalidæ, 507.
Leptocoma braziliana separata (Linn.), 31.
jugularis jugularis (Linn.), 271.
Lethrinus atkinsoni Seale, 506.
Leucotreron leucotis leclancheri, 18.
occipitalis occipitalis (Gray), 17.
LEUS-PALO, SIMEONA, *see* MENDOZA and LEUS-PALO.
Lichtensteinipicus fuliginosus (Tweedd.), 28.
Ligora cheyneana Harv., 513.
Limnophila Macq., 324.
punctum (Meig.), 324.
(Prionolabis) carbonis Alex., 315, 325, 326.
(Prionolabis) **nigrofemorata** Alex., 117, 118.
(Prionolabis) odai Alex., 119.
(Prionolabis) rufipennis Alex., 118.

Limnophila—Continued.
(Prionolabis) **yamamotana** Alex., 118.
Limonia fusciceps Alex., 112.
(Dicranomyia) consimilis (Zett.), 230.
(Dicranomyia) **gracilirostris** Alex., **469.**
(Dicranomyia) grahamiana Alex., 316.
(Dicranomyia) **lethe** Alex., **315**, 317.
(Dicranomyia) mesosternata (Alex.), 230.
(Dicranomyia) mesosternatoides (Alex.), 230.
(Dicranomyia) **tseni** Alex., **315.**
(Geranomyia) baliana Alex., 232.
(Geranomyia) fumimarginata **vaciva** Alex., **232.**
(Geranomyia) longifimbriata Alex., 231.
(Geranomyia) **torta** Alex., **230**, 231.
(Libnotes) **citrivena** Alex., **228**, 229.
(Libnotes) crocea (Edw.), 229.
(Libnotes) crocea **celestia** Alex., **229.**
(Lismonia) amabilis **antistes** Alex., **467.**
(Limonia) anthracina (Alex.), 315.
(Limonia) **egressa** Alex., **468**, 469.
(Limonia) fusciceps **nigricuspis** Alex., **112.**
(Limonia) improvisa Alex., 314.
(Limonia) nominata Alex., 467.
(Limonia) omniflava Alex., 315.
(Limonia) **perbeata** Alex., **314.**
(Limonia) **pernigrina** Alex., **466**, 467.
(Limonia) prudentia Alex., 467.
Limoniinæ, 112, 228, 314, 466.
Limoniini, 112, 228, 314, 466.
Limucon, 17.
Lipophleps Berg., 127.
Lipsothrix Loew, 115.
assamica Alex., **250**, 251.
Lithodidæ Dana, 184.
Littoral Paguridea in the collection of the University of the Philippines, 183.
Lizard fish, 560.
Lodong, 506.
fisheries, 508.
Loligo spp., 510, 511.
Longurio fulvus Edw., 98.
(Longurio) fulvus Edw., 98.
Loriculus philippensis worcesteri Steere, 22.
Loslosi, 510.
Lower fungi of the Philippine Islands, 7.
Lumitog, 506.
Lumut, 512.
Lutjanus spp., 506.
Lycopersicum esculentum Mill., 8.
Lyncornis macrotis macrotis (Vigors), 25, 33.

M

Macacus cynomolgus, 305.
Mackerel, chub, 507; Spanish, 507.
Macronous striaticeps mindanensis Steere, 29.
Macrophoma phaseolina F. Tassi, 11.
Macrophygia phasianella tenuirostris Bp., 19.
Macrosporium centaureae Roldan, 9.
Maiamaia, 506.
Malaga, 506.
Mamaclid, 518.
Mamata, 507.
Mandalada, 511.
Manihot utilissima Pohl, 9.
Manis javanica Desmarest, 1, 3; acanthocephalan parasite of, 1.
tricuspis, 1.
Manoaymasin, 518.
Manok ihalas, 16.
Manono, 518.
MARTIN, CLARO, Two rare Philippine fishes, 387.
MASILUNGAN, VICTORIA A., *see* TUBANGUI and MASILUNGAN.
Mataan, 507.
Maya, 32.
Mearnsia picina (Tweedd.), 26, 33.
Medicinal seaweeds, 512.
Medusæ, 383.
Megalaspis cordyla (Linn.), 506.
Megalops cyprinoides (Brouss.), 506.
Megalurus palustris forbesi Bangs, 30, 274.
tweeddalei McG., 270.
Megapodius, 274.
sp., 33, 272, 274.
Melosira binderana Kütz., 45.
distans (Ehr.) Kütz. var. alpigera Grun., 45.
distans (Ehr.) Kütz. var. lirata (Ehr.) Bethge fo. lacustris (Grun.) Bethge, 344.
granulata (Ehr.) Ralfs status b, 45.
granulata (Ehr.) Ralfs status x, 45.
roeseana Rabh. var. epidendron Grun., 344.
varians C. A. Agardh, 44, 479, 480.
MENDOZA, JOSE MIGUEL, and SIMEONA LEUS-PALO, A revision of Philippine Lepiota, 363.
Mene maculata (Bl. and Schn.), 506.
Meridion circulare Agardh, 46.
circulare Agardh. var. constricta (Ralfs) Van Heurck, 344.
Metapenæus rectacutus Alcock and Henderson, 40.
Microhierax erythrogenys erythrogenys (Vigors), 21.
meridionalis, 21.
Milkfish, 506.
Mingok, 21.
Mollusk fisheries, 509.
Molophilus albibasis Alex., 475.
bilobulus Alex., 475.
nigropolitus Alex., 475.
trifilatus Alex., 340.
uniclavatus Alex., **340.**

Molophilus—Continued.
(Molophilus) **bilobulus** Alex., **474.**
(Molophilus) **furiosus** Alex., **338.**
(Molophilus) gracilis, 338, 339, 474.
(Molophilus) **uniclavatus** Alex., **339.**
Monamon, 507.
Monorchotrema, 299.
calderoni Africa and Garcia, **299.**
taichui Nishigori, 304.
yokogawai Katsuta, 304, 305.
Moonfish, spotted, 506.
Moorhen, 19.
Moray, painted, 506.
Mud skipper, goby, 506.
Mugil seheli Forsk., 506, 508.
spp. 506, 507.
Mugilidæ, 506.
Mullet, 506.
Mullidæ, 506.
Mulmul, 507.
Munia atricapilla minuta (Meyen), 32, 274.
Murænesox cinereus (Forsk.), 507.
Murrel, 506.
Muscadivores chalybura, 18.
Mycobacterium lepræ, 155.
MYERS, ROLLIN G., The effect of arsenic, vanadium, iron, and tin on the determination of antimony in high-lead mixtures by a modified permanganate method, 75.
Mytilus smaragdinus Chemnitz, 510.

N

Navicula Bory, 53.
americana Ehr., 53.
amphibola Cleve, 59, 486.
amphibola var. manshurica Skv., 44, 59.
anglica Ralfs, 58.
argunensis Skv., 44, **54.**
atoms (Naeg.) Grun., 55, 348.
bacillum Ehr. var. **parallela** Skv., 44, 53.
cincta (Ehr.) Kütz., 57, 485.
cincta (Ehr.) Kütz. fo. **sphagnicola** Skv., 161, **169.**
cincta (Ehr.) Kütz. var. leptocephala (Breb.) Grun., 57.
crucicula, 54.
crucicula (W. Sm.) Donk. var. obtusata Grun., 43, 54.
cryptocephala Kütz., 55, 347.
cryptocephala Kütz. var. exilis Kütz., 486.
cryptocephala Kütz. var. veneta (Kütz.) Grun., 43, 55, 485.
cuspidata Kütz., 53.
cuspidata Kütz. var. ambigua (Ehr.) Cleve, 43, 44, 53.
falaisiensis Grun. var. lanceola Grun., 58, 486.
gastrum (Ehr.) Donk., 44, 58.
gracilis Ehr., 485.
hasta Pant., 486.
hungarica Grun. var. capitata (Ehr.) Cleve, 57.

Navicula—Continued.
hungarica Grun. var. **lanceolata** Skv., 44, **57.**
hungarica Grun. var. linearis Oestrup, 43, 56.
ignota Krasske, 169.
lagerheimi Cleve var. intermedia Hust., 347.
Lambda Cleve var. densistriata Skv., 53.
Lambda Cleve var. nipponica Skv., 53.
lanceolata (Agardh) Kütz., 44, 58.
muscosa Skv., 161, 168.
oblonga Kütz. var. subparallela Rattray, 44, 59.
peregrina (Ehr.) Kütz., 485.
peregrina (Ehr.) Kütz. var. **sinica** Skv., **486.**
placenta Ehr., 168, 348.
placentula (Ehr.) Grun., fo. latiuscula (Grun.) Meister, 58.
placentula (Ehr.) Grun. fo. rostrata A. Mayer, 58.
protracta Grun., 43, 54, 55.
pupula Kütz. var. capitata Hust., 43, 54.
pupula Kütz. var. elliptica Hust., 43, 54.
pupula Kütz. var. rectangularis (Greg.) Grun., 347.
pupula Kütz. var. rostrata Hust., 54.
pusio Cleve, 485.
radiosa Kütz., 57.
reinhardtii Grun., 57.
reinhardtii Grun. fo. gracilior Grun., 486.
rhynchocephala Kütz. var. **tenua** Skv., 43, 44, 55, **485.**
rostellata Kütz., 56.
salinarum Grun., 485.
sohrensis Krasske var. **parallela** Skv., 161, **168.**
viridis var. isostauron Grun., 61.
viridula Kütz., 43, 55.
viridula Kütz. var. argunensis Skv., 44, 56.
viridula Kütz. var. **rostrata** Skv., 44, **56.**
viridula Kütz. var. slesvicensis (Grun.) Cleve, 56.
Naviculæ bacillares Cleve, 53.
decipientes Cleve, 54, 55.
lineolatæ Cleve, 55.
menisculæ Cleve, 55, 168.
orthostichæ Cleve, 53.
punctatæ Cleve, 59.
Neidium affine (Ehr.) Cleve fo. hercynica (A. Mayer) Hust., 51.
affine (Ehr.) Cleve var. amphirynchus (Ehr.) Cleve, 51.
bisulcatum (Lagerst.) Cleve, 50, 167.
bisulcatum (Lagerst.) Cleve fo. undulata O. Müll., 167.
dubium (Ehr.) Cleve, 43, 51.
dubium (Ehr.) Cleve fo. argunensis Skv., 43, 44, 52.
iridis (Ehr.) Cleve, 51.
iridis (Ehr.) Cleve var. amphigomphus (Ehr.) Van Heurck, 51.

Neidium—Continued.
iridis (Ehr.) Cleve var. ampliata (Ehr.) Cleve, 167.
productum (W. Sm.) Cleve, 51.
Nephridiocanthus manilensis, 1.
Nephridiorhynchus Mey., 1.
major (Bremser), 3, 4.
palawanensis Tubangui and Masilungan, **1, 2.**
palawanensis sp. nov., an acanthocephalan parasite of Manis javanica Desmarest, 1.
Nephrotoma, 451.
medipubera Edw., 108.
nigrirostris Edw., 109.
nigrocentalis Alex., **106.**
nigrostylata Alex., 228.
pallidapex Alex., **108,** 109.
parva (Edw.), 227.
Ninox philippensis Bp., 21.
Nitzschia acicularis W. Sm., 43, 44, 69, 492.
acuta Hantz., 68.
amphibia Grun., 69.
angustata (W. Sm.) Grun., 491.
capitallata Hust., 178.
capitellata Hust. var. **montana** Skv., 161, 178, 343, **358.**
capitellata Hust. var. sinica Skv., 68.
commutata Grun., 44, 68.
dissipata (Kütz.) Grun., 492.
flexa Schum., 69.
frustulum (Kütz.) Grun. var. perminuta Grun., 44, 69, 179, 357.
frustulum (Kütz.) Grun. var. perpusilla (Rabh.) Grun., 492.
frustulum (Kütz.) Grun. var. tenella Grun., 178.
gracilis Hantz., 68.
ignorata Krasske var. asiatica Skv., 343, **358.**
linearis W. Sm., 491.
linearis W. Sm. var. tenuis (W. Sm.) Grun., 492.
palea (Kütz.) W. Sm., 68, 357, 492.
parvula Lewis, 358.
recta Hantz., 68.
sigmoidea (Ehr.) W. Sm., 69, 492.
subvitrea Hust. var. **maxima** Skv., **492.**
tryblionella Hantz. var. debilis (Arn.) A. Mayer, 178.
tryblionella Hantz. var. levidensis (W. Sm.) Grun., 44, 67.
Nothoderus Alex., 223.
australiensis (Alex.), 223.
Nudagobioides Shaw, 261.
Nueva Vizcaya Province, fisheries of, 516.

O

Octupus spp., 510, 511.
Okian, 510.
Oligatanthorhynchus pomatostomi (Johnston and Cleland), 3.
Onnok, 509.
Operphora marthyi Herib., 46.
Ophicephalus striatus Bl., 506.
Ophiocara aporos Blkr., 509.
Orchids, Philippine, 141.
Orectolobus barbatus Jordan and Fowler, 388.
japonicus Müll. and Henle, 388.
japonicus Regan, 388.
Oreomyza, 106.
Oriolus chinensis chinensis Linn., 32, 271.
xanthonotus samarensis Steere, 32.
Ormosia aculecta, 473, 474.
arisanensis Alex., 474.
beatifica Alex., 335.
defessa Alex., **335,** 336.
insolita Alex., **473.**
similis, 335.
solita Alex., 474.
tenuispinosa Alex., 336.
Oropeza, 226.
Orthotomus frontalis Sharpe, 30.
Osoos, 507.
Ostrea spp., 510.
Otus bakkamoena everetti (Tweedd.), 21.
Oxydiscus de Meijere, 324.
(Oxydiscus) issikina (Alex.), 324.
(Oxydiscus) **latior** Alex., **472.**
(Oxydiscus) latissimus (Alex.), 473.
(Oxydiscus) **reductus** Alex., **322,** 324.

P

Pachyrrhima parva Edw., 227.
Padas, 502.
Pagahan, 381.
Pagurias J. E. Benedict, 194.
Paguridæ Alcock, 184, 185.
Dana, 184.
Stebbing, 184, 185.
Paguroidæ Boas, 184.
Paguridea Dana, 183, 184; littoral, 183.
Pagurinæ Ortmann, 185.
Paguristes, 185.
Paguropsis, 185.
Pagurus Dana, 183, 185.
F., 194, 195, 201.
aniculus F., 201.
asper de Haan, 195–197.
cavipes White, 195.
clibanarius Latr., 190.
corallinus Milne-Edw., 187.
cruentatus Milne-Edw., 189.
cultratus White, 195.
dearmatus Henderson, 195, **196.**
decorus Randall, 206.
deformis Milne-Edw., 195, **197.**
depressus Hllr., 200.
elegans Milne-Edw., 206.
euopsis Dana, 195, 200.
fabimanus Dana, 195, 199.
guttatus Oliv., 105, 200.
lævimanus Randall, 205.

Pagurus—Continued.
latens Randall, 207.
laticauda (Latr.) Cuv., 214.
latro Latr., 214.
magistos Oliv., 197.
pictus Owen, 206.
punctulatus Oliv., 195, 197, 198, 200.
setifer Hess, 200.
tibicen Milne-Edw., 205.
tuberculosus Milne-Edw., 192, 193.
ursus Oliv., 201.
vulnerans Thallwitz, 195, 198.
wood-masoni Alcock, 195, 198.
(Clibanarius) eurysternus Hilgendorf, 189.
Painted moray, 506.
Palagó, 29.
Palamoniæ, 505.
Paliling, 507.
Palingato, 516.
Palo, 507.
Paltat, 507.
Pampano, 506.
Pana, 518.
Pangolin, 1.
Papagurus Brandt, 185.
Paphia hinatina Lam., 510.
strata Chemnitz, 510.
Paragó, 29.
Parapaguridæ Sm., 184.
Parapenæus rectacutus de Man, 40.
PARAS, ERNESTO M., Chemical fractionation of leprotic nodules, I. Isolation of the lipid fractions, 155.
Parrot fish, 507.
Pateng, 502.
Pedicia (Tricyphona) formosana (Alex.), 472.
(Tricyphona) glabripennis (Brun.), 472.
(Tricyphona) immaculata, 471.
(Tricyphona) **omeiana** Alex., **471**, 472.
Pediciini, 115, 319, 471.
Penæidæ, 37; Philippine, 35.
Penæus F., 35, 37, 507; Philippine species of, 35.
affinis Milne-Edw., 35, 37, 507.
anchoralis Spence Bate, 35, 38, 39.
canaliculatus Oliv., 35, 37.
canaliculatus Ortmann, 38.
canaliculatus var. japonicus Spence Bate, 35, 37, 38.
incisipes Spence Bate, 35, 38, 507.
indicus Milne-Edw., 35, 38, 507.
indicus var. longirostis de Man, 35, 38, 39.
japonicus Nobili, 38.
monodon F., 35, 38, 507.
monodon var. **manilensis** Villaluz and Arriola, 35, 38, **39**.
rectacutus Spence Bate, 35, 38, 40.
semiculcatus, 507.
Penelopides panini boholensis, 24.
panini leytensis, 24.
panini samarensis Steere, 24, 25.
Perch, climbing, 506; glass, 506.
Perico, 22.
Pericrocotus flammeus leytensis Steere, 33.
Periophthalmus barbarus (Linn.), 506.
Pernis apivorus ptilorhynchus (Temm.), 20.
Petrochirus, 185.
Phapitreron amethystina amethystina Bp., 17.
leucotis albifrons McG., 17.
leucotis brevirostris, 17.
Pharella acutidens Broderip Sowerby, 510.
Phaseolus ornithoppus, 11.
vulgaris Linn., 11.
Philippine fishes, 387.
Lepiota, 363.
orchids, 141.
Penæidæ, 35.
shrimps, 35.
Pholas orientalis Gmel., 380.
Phyllosticta heveæ Zimm., 11.
phytolaccæ Cke., 12.
Phytolacca dioica Linn., 12.
Picoy, 22.
Pigeon, yellow-breasted fruit, 18.
Piko eel, silver, 507.
Pinna, 497; Philippine, 497.
hanleyi, 497.
incurvata Chemnitz, 497.
japonica Hanley, 497.
Pinnularia Ehrenb., 169, 343, 348.
acrosphaeria Breb., 173, 351.
appendiculata (Agardh) Cleve, 169.
bogotensis Grun. var. **asiatica** Skv., **343**, 350.
borealis Ehr., 60, 351.
braunii (Grun.) Cleve, 170, 349.
brevicostata Cleve, 172, 351.
distinguenda Cleve, 176, 353.
distinguenda Cleve var. **asiatica** Skv., 161, 175, **353**.
distinguenda Cleve var. asiatica Skv. fo. **striolata** Skv., 343, **354**.
distinguenda Cleve var. sphagnalis Skv., 161, **175**.
divergens W. Sm., 171.
divergens W. Sm. var. elliptica Grun., 171.
divergens W. Sm. var. undulata Herib. and Per., 171.
divergentissima (Grun.) Cleve var. lata Skv., 161, 170.
episcopalis Cleve, 171.
gentilis (Donk.) Cleve, 352.
gentilis (Donk.) Cleve var. sibirica Skv., 161, 174.
gibba Ehr., 172, 349, 350.
gibba Ehr. fo. **constricta** Skv., 343, **350**.
gibba Ehr. var. linearis Hust., 350.
gibba Ehr. fo. **polymorpha** Skv., 161, **172**.
gibba Ehr. fo. subundulata Mayer, 172, 350.

Pinnularia—Continued.
gibba Ehr. var. linearis Hust., 172.
interrupta W. Sm., 59.
isostauron (Ehr.) Grun., 61, 354.
isostauron (Ehr.) Grun. var. **orientalis** Skv., 162, **175**
karelica var. japonica Hust., 170.
karelica Cleve var. **subcapitata skv.**, 161, **170.**
legumen Ehr., 170.
major (Kütz.) Cleve fo., 60.
major (Kütz.) Cleve var. linearis Cleve, 173.
major (Kütz.) Cleve var. linearis Cleve fo. neglecta Mayer, 173, 351.
mesolepta (Ehr.) W. Sm., 59, 349.
mesolepta (Ehr.) Sm. fo. angusta Cleve, 169, 349.
microstauron Ehr., 60.
microstauron (Ehr.) Cleve, 349.
microstauron (Ehr.) Cleve var. brebissonii (Kütz.) Hust. fo. linearis O. Müll., 60.
molaris Grun. var. **asiatica** Skv., 343, **348.**
nobilis Ehr., 352.
nobilis Ehr. var. **distincta** Skv., 161, **174.**
nobilis Ehr. var. fossilis Pant., 61, 174.
nobilis Ehr. var. parallella Skv., 161, 174.
nodosa Ehr. var. Hankensis Skv., 343, 351.
sphagnicola Skv., 162, **175.**
streptoraphe Cleve, 352.
streptoraphe Cleve var. **asiatica** Skv., 343, **353.**
streptoraphe Cleve var. interrupta Skv., 174.
streptoraphe Cleve var. minor Cleve, 61, 353.
subcapitata Greg., 348.
subcapitata Greg. fo. **constricta** Skv., 343, **348.**
subcapitata Greg. fo. **tenua** Skv., 161, **169.**
subcapitata Greg. var. hilseana (Janish) O. Müll., 349.
subsolaris (Grun.) Cleve var. **asiatica** Skv., 161, **171.**
tibetana Hust. var. **argunensis** Skv., 44, **59.**
tibetana var. stauroneiformis Skv., 59.
viridis (Nitz.) Ehr., 60, 486.
viridis (Nitz.) Ehr. var. commutata Grun. fo. **argunensis** Skv., 44, **60.**
viridis var. distinguenda Cleve, 353.
viridis (Nitz.) Ehr. var. fallax Cleve, 173, 352.
viridis var. intermedia Cleve, 174.
viridis var. minor Cleve, 61.
viridis (Nitz.) Ehr. var. **orientalis** Skv., 161, **173.**
viridis (Nitz.) Ehr. var. sudetica (Hilse) Hust., 352.
sp., 352.
Pinnulariæ brevistriatæ, 172, 351.
capitatæ, 169, 348.
complexæ, 352.
distantes, 351.
divergentes, 170, 349.
majores, 173, 351.
parallelistriatæ, 348.
tabellariæ, 172, 349.
Piricularia cannae Roldan, 10.
grissea (Cke.) Sacc., 11.
Pitao, 268.
Pitres, 382.
Pitta sordida sordida (P. L. S. Müller), 33.
Pleurosigma, 49.
acuminatum (Kütz.) Grun., 49.
Plocimas magnificus End., 93.
Poaephyllum Ridl., 141, 150, 151.
grandiflorum Quis., 141, **150.**
parviflorum (J. J. Sm.) Ridl., 151.
Polioiophus urostictus urostictus (Salv.), 33.
Poliolimnas cinereus (Vieillot), 33.
Polydactylus seali (Jordan and Rich.), 506.
Pomacentridæ, 506.
Pongao, 21.
Porong, 507.
Porgy, 506.
Potamides (telescopium) telescopium Linn., 510.
(terebralia) sulcatus Born, 510.
Prioniturus, 22.
discurus discurus (Vieillot), 22.
Prionochilus inexpectatus Hartert, 30, 31.
olivaceus Tweedd., 31.
Prionolabis, 119.
Prionota nigriceps Alex., 94.
nigriceps van der Wulp, 94.
Progonomyia Alex., 127.
Protanyderus alexanderi Kariya, 224.
Protogonomyia Alex., 127.
Protohelius, 115.
tinkhami Alex., **113,** 114.
Protoplasa fitchii, 223.
Psalliota (Agaricus) boltoni, 363.
Pselliophora O. S., 98, 313.
ardens O. S., 224.
ardens (Wied.), 224.
biaurantia Alex., **96,** 97.
chaseni Edw., 96.
ctenophorina Riedel, 97.
fuscipennis (Macq.), 98.
kangeanensis Alex., **94.**
luctuosa de Meijere, 95, 224.
speciosa Adw., 97.
stabilis Alex., 97.
stigmatica de Meijere, 95, 96.
stigmatica **flavoscutellaris** Alex., **95.**
upsilon Alex., **97.**
Psettodes erumei (Bl. and Schn.), 506.
Pseudotynx philippensis mindanensis Grant, 21, 33.
Ptilocichla minuta Bourns and Worcester, 29.
Ptillostena Berg., 126, 127.

Ptilostenodes Alex., 127.
Pukpuklo, 512.
Punay, 17, 268.
Puspusit, 510.
Pu-yo, 381.
Pycnonotus goiavier goiavier (Scop.), 29.
Pylochelidæ Spence Bate, 184.
Pyrreroidios manilensis, 305.

Q

Quioet, 507.
QUISUMBING, EDUARDO, Studies on Philippine orchids, I, 141.
Qurarato, 507.

R

RABOR, DIOSCORO S., Birds from Leyte, 15; The avifauna of the Gigante Islands, 267.
Radinoderus Handlirsch, 223.
dorrigensis Alex., 223.
occidentalis (Alex.), 223.
terræ-reginæ (Alex.), 223.
Rallus torquatus torquatus Linn., 33, 268.
Ramphalcyon capensis gigantea (Walden), 23.
Rarang, 510.
Remora albescens Blkr., 387.
Rhaphidolabis, 117.
Rhinomyias ruficauda mindanensis Mns., 28.
ruficauda samarensis, 28, 29.
Rhipidura javanica nigritorquis Vigors, 270.
superciliaris samarensis (Steere), 28.
Rhoicosphenia curvata (Kütz.) Grun., 479, 483.
Rhopalodia gibba (Ehr.) O. Müll., 66.
gibba (Ehr.) O. Müll. var. ventricosa (Ehr.) Grun., 44, 66.
gibberula (Ehr.) O. Müll., 44, 67.
ROLDAN E. F., New or noteworthy lower fungi of the Philippine Islands, II, 7.
ROXAS, HILARIO A., and GUILLERMO L. ABLAN, A new tænioid fish from Occidental Negros, 261.
Rhyacichthys aspro Kuhl and Van Hasselt, 506, 500.
Rhynchobalus djiddensis Forsk., 506.
Riprippiis, 512.
Roncador, 506.
Round-bodied herring, 507.
Rudder fish, 506.
Ruprupuuc, 512.

S

Saccharum officinarum Linn., 7.
Salak, 23.
Salsalamagui, 512.
Samanea saman (Jacq.) Merr., 371.
Samaral, 511.
Sandpiper, 20.
SANTOS, F. O., *see* GUTIERREZ and SANTOS.
Sapiao, 502.
Sapsap, 507.
Sarcophanops samarensis Steere, 28.
Sarcops melanonotus Grant, 32, 271, 272.
Sardine, 506.
Sardinella fimbriata (Cuv. and Val.), 507.
longiceps (Cuv. and Val.), 507.
moluccensis Blkr., 507.
perforata, 507.
Sargasum siliquosum J. Ag., 513.
Saurida tumbil (Bl.), 506.
Sauropatis chloris collaris (Bodd.), 269.
Saya-saya, 270.
Scatophagus argus Bodd., 506.
Schummelia, 227.
Scianidæ, 507.
Scomber microlepidotus, 507.
lysan (Forsk.), 506.
Scutengraulis hamiltonii (Gray), 507.
Sea catfish, 506.
horse, 254.
Seaweeds, edible, 512.
Seckeran, 507.
Sepia spp., 510, 511.
Shad, gizzard, 506.
Shark, 382, 506; hammerhead, 506.
Shrimps, Philippine, 35.
Sicub, 20.
Sicup, 20.
Sicyopterus lacrymosus Herre, 507, 509.
Siganid, 506.
Siganid-fry fisheries, 511.
Sigay, 511.
Sillago sihama Forsk., 507.
Silver piko eel, 507.
Silver-bar fish, 506.
Silverside, 507.
Simong, 510.
Sinigang, 509.
Sinotipula Alex., 441.
Singitan, 510.
Siriw, 507.
Sisiao, 507.
Skipper, goby mud, 506.
SKVORTZOW B. W., Diatoms from Argun River, Hsing-An-Pei Province, Manchoukuo, 43; Diatoms from a peaty bog in Lianchiho River valley, eastern Siberia, 161; Diatoms from a mountain bog, Kaolingtze, Pin-Chiang-Sheng Province, Manchoukuo, 343; Diatoms from Chengtu, Szechwan, western China, 479.
Slipmouth, 506.
Snakes, water, 382.
Snapper, 506; gray, 506.
Soletellina (Psammotæa) minor Deshayes, 510.
(Soletellina) cummingiana Deshayes, 510.
Spanish mackerel, 507.
Sphagnum, 161,, 347.
Sphyræna aureoflammæ Seale, 506.
Sphyrna zygæna (Linn.), 506.

Spilornis holospilus holospilus (Vigors), 20.
Spotted guitar fish, 506.
moonfish, 506.
Stauroneis acuta W. Sm., 52.
anceps Ehr., 52, 168.
anceps Ehr., fo. gracilis (Ehr.) Cleve, 52, 347.
anceps Ehr. fo. linearis (Ehr.) Cleve, 168.
phoenicenteron Ehr., 168, 347, 484.
phoenicenteron Ehr. fo. gracilis Dip., 52, 347.
smithii Grun., 485.
Stenopterobia intermedia (Lewis), 178, 358.
Stephanodiscus hantzschii Grun., 46.
Streptopelia bitorquata dussumieri (Temm.), 268, 272.
Strix whiteheadi, 305.
Styringomyia, 256.
acuta Edw., 256.
angustitergata Alex., **256**, 257.
armata Edw., 256.
bicornuta Alex., **130**, 131.
claggi Alex., 256.
curvispina Edw., 256.
ensifera Edw., 256.
geminata, 255.
holomelania Alex., 131, 256.
melania Edw., 131.
reducta Alex., 253, 254.
spathulata Alex., 256.
transversa Edw., 256.
Sugpo, 35.
Surirella angustata Kütz., 71, 179, 358.
bengalensis Grun., 479, 494.
biseriata Breb. fo. punctata Meister, 70.
capronii Breb., 71, 493.
gracilis Grun., 71.
linearis W. Sm., 70, 493.
linearis W. Sm. var. constricta (Ehr.) Grun., 493.
linearis W. Sm. var. helvetica (Brun) Meister, 70, 493.
linearis W. Sm. var. **vermifera** Skv., **493.**
ovata Kütz., 41, 44, 71.
ovata Kütz. var. pinnata (W. Sm.), 44, 71, 493.
pantocsekii Meister, 71.
robusta Ehr. fo. lata Hust., 44, 70.
robusta Ehr. var. splendida (Ehr.) Van Heurck, 70.
spiralis Kütz., 493.
tenera Greg., 72.
tientsinensis Skv., 44, 71.
Surniculus lugubris velutinus (Shp.), 26, 269, 274.
Susueldotbaby, 513.
Synedra acus Kütz., 479, 481.
acus Kütz. var. radians (Kütz.) Hust., 47.
parasitica W. Sm., 479, 482.
Synedra—Continued.
parasitica (W. Sm.) var. subconstricta Grun., 47.
rumpens Kütz. var. meneghiniana Grun., 479, 482.
ulna (Nitz.) Ehr., 43, 47, 344, 479, 481.
ulna (Nitz.) Ehr. var. aequalis (Kütz.) Hust., 47.
ulna (Nitz.) Ehr. var. amphirhynchus (Ehr.) Grun., 481.
ulna (Nitz.) Ehr. var. lanceolata Kütz. 47, 481.
ulna (Nitz.) Ehr. var. lanceolata Kütz. fo. **constricta** Skv., **481.**
ulna (Nitz.) Ehr. var. **tenuirostris** Skv., **481.**
vaucheriæ Kütz, 47, 479, 481.
vaucheriæ Kütz. var. capitata Skv., 482.
vaucheriæ var. capitellata, 482.

T

Tabac, 502.
Tabellaria fenestrata (Lyngb.) Kütz., **46**, 162, 344.
flocculosa (Roth.) Kütz., 344.
Tabon, 273.
Tabong, 20.
Taco, 502.
Tænioid fish, 261.
Tænioides Lacép., 261.
caniscapulus Roxas and Ablan, **261.**
hermannianus, 261.
Tagad, 381.
Tagsing, 271.
Takray, 269.
Talakitok, 507.
Talibucno, 507.
Taló, 497.
Tamales, 509.
Tamban, 507.
Tambor, 514.
Tambulog, 497.
Tangar, 511.
Tanyderidæ, 221, 223.
Tanygnathus lucionensis lucionensis (Linn.), 32, 273, 274.
Tanyptera angustistyla Alex., 311.
antica Alex., **310** 311.
Tañguigui, 507.
Taosi, 25.
Taquit, 508.
Tarab, 497.
Tarpon, 506.
Tarik, 502.
Tariptip, 507.
Tayog, 511.
Teg, 508.
Therapon argenteus, 302.
jarbua Forsk., 506.
plumbeus Kner, 507.
Thunnidæ, 507.
Threadfin, 506.

Thriponax pectoralis Tweedd., 28.
Ti-i, 507.
Tin, effect of, on the determination of antimony in high-lead mixtures by a modified permanganate method, 75.
Tinaja, 507.
Tipula, 102, 441.
bicornuta, 102.
gracillima, 99.
gracilirostris Alex., 439.
nokonis Alex., 100.
tridentata Alex., 106.
venusta, 99.
(Oreomyza) **compressiloba** Alex., 455, 456, 458.
(Oreomyza) **interrita** Alex., 449.
(Oreomyza) **laetibasis** Alex., 453.
(Oreomyza) **laetissima** Alex., 452.
(Oreomyza) mutila, 460.
(Oreomyza) mutiloides Alex., 462.
(Oreomyza) **niitakensis** Alex., 104, 105.
(Oreomyza) **percommoda** Alex., 457, 458.
(Oreomyza) **perlata** Alex., 450, 452.
(Oreomyza) **pertenuis** Alex., 460, 462.
(Oreomyza) **procliva** Alex., 458, 460.
(Oreomyza) **sexlobata** Alex., 454, 455, 456.
(Oreomyza) submutila Alex., 462.
(Oreomyza) tridentata Alex., 106.
(Schummelia) bicolorata Alex., 226, 227.
(Schummelia) **bilobula** Alex., 441, 442.
(Schummelia) **cumulata**, 443, 444.
(Schummelia) honorifica Alex., 444.
(Tipulodina) **amabilis** Alex., 99, 100.
(Tipulodina) **cantonensis** Alex., 444, 446.
(Tipulodina) gracillima Brun, 100.
(Tipulodina) hopiensis Alex., 445, 446.
(Vestiplex) **bicornigera** Alex., 102.
(Vestiplex) bicornuta Alex., 104.
(Vestiplex) deserrata Alex., 102.
(Vestiplex) divisotergata Alex., 447.
(Vestiplex) **inquinata** Alex., 446.
(Vestiplex) nokonis Alex., 100, 102.
(Vestiplex) **subtestata** Alex., 447, 448.
(Vestiplex) **takahashiana** Alex., 101.
(Vestiplex) testata Alex., 448.
Tipulidæ, 102, 119, 127, 221, 224, 310, 463.
from eastern Asia, 93, 221, 309, 439.
Tipulinæ, 93, 224, 310, 439.
Tiratira, 406.
Tirem, 510.
To Have and To Be in Iloko, 417.
TOPACIO, TEODULO, *see* ACEVEDO and TOPACIO.
Toyotoyan, 518.
Trematodes of the genus Haplorchis (Heterophyidæ), 299.
Trentepohlia (Plesiomongoma) **callinota** Alex., 251, 252.
(Plesiomongoma) candidipes Edw., 252.
Treron pompadora axillaris Bp., 17, 18.
vernans vernans (Linn.), 268, 271.
Trichiurus haumela (Forsk.), 506.
Trichocera **appendiculata** Alex., 309, 310.
Trichoceridæ, 309.
Tricholimnophila Alex., 324.
Trocha, 510.
Trochus maximus Koch, 510.
Troglopagurus, 185.
TUBANGUI, MARCOS A., and VICTORIA A. MASILUÑGAN, Nephridiorhynchus palawanensis sp. nov., an acanthocephalan parasite of Manis javanica Desmarest, 1.
Tuel, 503.
balat, 514.
ñgirñgir, 514.
rongaab, 514.
Tukmo, 268.
Tulamís, 271.
Tuñgi, 507.
Turbo marmoratus Linn., 510.
Turnix suscitator fasciata (Temm.), 268.
Turus, 511.
Tylosurus giganteus (Schlegel), 506.
spp., 507.

U

Umbrina spp., 506.
Uroloncha leucogastra everetti (Tweedd.), 32.
Usoc, 381.
Usub, 507.
Uwak-uwak, 32.

V

Vanadium, effect of, on the determination of antimony in high-lead mixtures by a modified permanganate method, 75.
VANOVERBERGH, MORICE, "To Have" and "TO BE" in Iloko, 417.
Vestiplex Bezzi 102, 106.
VILLALUZ, DOMICIANO K., and FELIX J. ARRIOLA, Five other known species of Penæus in the Philippines, 35.
Viray, 513.
Virot, 507.
Vitis vinifera Linn., 10.
Vivipara angularis Müll., 510.

W

Walo-walo, 382.
Water snakes, 382.
Whiting, 507.

Y

YAP-CHIONGCO, JOSE, The littoral Paguridea in the collection of the University of the Philippines, 183.
Yellow leatherjacket, 506.
Yellow-breasted fruit pigeon, 18.
Yomoyobyob, 511.
Yungipicus maculatus (Scop.), 270.

Z

Zonophaps poliocephala nobilis, 18, 19.
poliocephala poliocephala, 17–19.
Zosterops palpebrosa basilanica Steere, 30.

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CONTENTS

Page

GUTIERREZ, M., and F. O. SANTOS. The food consumption of one hundred four families in Paco District, Manila........ 397

VANOVERBERGH, MORICE. 'To have' and 'To be' in Iloko........ 417

ALEXANDER, CHARLES P. New or little-known Tipulidæ from eastern Asia (Diptera), XXXIX........ 439

SKVORTZOW, B. W. Diatoms from Chengtu, Szechwan, western China........ 479

ABLAN, GUILLERMO L., and GODOFREDO L. ALCASID. Two species of Pinna apparently new to the Philippines........ 497

BLANCO, GUILLERMO J. Fisheries of northeastern Luzon and the Babuyan and Batanes Islands........ 501

BOOKS........ 523

INDEX........ 531

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